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Qualifications of Commissioners

A number of vacancies are to be filled in the Public Service Commissions of New York, and the Governor is now being importuned to heed the recommendations of various factions in making choice of fit persons for the positions. We have already placed on record our estimation of what should be the make-up of a properly constituted public service commission. Based solely on a survey of the work of commissions and bearing in mind that no one body of men possesses a mortgage on all the brains of the country, we have maintained that one member should be an engineer of eminent qualifications, one an expert accountant, one an economist of repute, another a lawyer of broad experience, and a fifth member one who possesses special knowledge of transportation questions. Regulation has not yet been so rooted in the structure of the body politic that as a principle it can by either the public or the utilities be regarded as settled. Indeed, it is now being weighed in the balances, and if it is found wanting, municipal ownership and operation is the only logical outcome. Utilities should insist on regulation which is fearless and just, and this can only be obtained from truly representative commissions. Theirs is an economic and not a political function. A commission made up entirely of lawyers or politicians, though they may be beyond reproach, is not properly constituted for the work of public service regulation.

Emergency-Service Radio Apparatus

Elsewhere in this issue mention is made of the fact that during the past few weeks radio inspectors in the United States Department of Commerce have refused to permit transatlantic steamships to leave United States ports because of defective wireless apparatus. It is decidedly unfortunate if such conditions are common, as the instances noted would seem to indicate. In case of accident at sea, which is likely to put the ship's engine room out of commission in short order, the storage-battery and induction-coil transmitter are relied upon to call for help by radio. When the emergency transmitter itself is put out of commission by a damp insulator or a defective interrupter, as in the two recent cases, the sublime confidence of the seagoing public in wireless as an all-potent savior would appear misplaced. It is high time that all passenger steamers were equipped with emergency or auxiliary transmitters which are really worthy of the name. The present fault is not the result of an inherent limitation of radio signaling itself, but, rather, of a policy of false economy in expenditures for equipment.

Uniformity in Service Rules

In Wisconsin, as in many other states, there is an almost complete lack of uniformity on such matters as the policy to be followed in defraying the cost of making extensions of distribution lines, the amount of discount on bills, the amount of deposit required from customers, if any, and, in general, the rules affecting relations with customers. Complying with a suggestion of the Railroad Commission of the State, the Wisconsin Electrical Association has appointed a committee on uniform policies for electric distribution-system extensions and commercial-service rules. While it is, of course, improbable that complete uniformity in these respects can be effected all over the State, there seems to be no reason why like policies should not be adopted in communities of about the same size where like conditions prevail. In its work of applying to the electrical utilities of the State for information on these subjects the committee should receive the hearty support of all the electric-service companies and municipal plants in the State. Moreover, the subject could well be taken up by other state associations.

Energy Basis for Street Lighting

The recommendations of a committee of the City Club of Milwaukee as to the steps to be taken for the solution of the street-lighting problem in that city, abstracted elsewhere in this issue, are of more than passing interest. The plan advocated is to contract with the city for the purchase of electrical energy for street lighting, on the kilowatt-hour basis, leaving the type of street-lighting equipment to be determined by the city and the purchase of such equipment to be made directly at the city's expense. One of the economic reasons urged for this plan is the elimination of any double payments for depreciation on equipment, but still more important is the flexibility of the plan which would enable the city to purchase improved street-lighting appliances as fast as would be justified on economic grounds without the political turmoil of a change of contract. At the present time there is a strong temptation for any central-station company to leave well enough alone and attempt to make no change in an existing street-lighting contract until it expires, unless the contract be for a much longer term than is now common. The plan proposed is not altogether novel, as some cities have purchased street-lighting energy on the kilowatt-hour basis for years, nor is it altogether new for the city to own the lamps and equipment. It is not devoid of merit as a substitute for the common present basis of so much per lamp year

for a given type of lamp for a certain term of years. The ownership of the poles, conduits and wires used for street-lighting purposes should not, however, be carried to the point of unnecessary duplication of equipment of this type already owned by the supplying company.

Alternating-Current Supply in New York City

The station of the United Electric Light & Power Company on the Harlem River at 201st Street, New York, described in part elsewhere in this issue, serves to emphasize the rapid advances which have been made in central-station engineering practice in recent years. Its general scheme is characteristic of Murray design in that the arrangement of the coal and ash handling equipment, boilers, turbines, exciters, switches, control, etc., does not differ materially from that in the Waterside and other stations built by the same engineer. As in the other stations in New York City referred to, the aim has been to provide for any blowout, short-circuit or other accident in such a manner that the rest of the system, not directly affected, should not be tied up. To accomplish this result feeders, connections, leads, buses, etc., have been thoroughly insulated and isolated, so that trouble on one line cannot be communicated to another and thus interfere with continuity of service. The same precautions are seen in the underground distribution system connecting the 201st Street station with the Waterside stations of the New York Edison Company.

Chief among the noticeable features in the new station is its small boiler equipment compared to that in the Waterside Station No. 2, for instance. Each station is rated at 120,000 kw, and yet the 201st Street station of the United Electric company has only thirty-two boilers while the New York Edison station has ninety-six. This great difference in steaming capacity is due primarily to the use of bituminous coal and also to the better water rates of the turbines and auxiliary steam equipment. The Waterside boilers were designed to burn No. 3 buckwheat coal, which was hand-fired; but the increasing price of the low-grade anthracite has also compelled the adoption of bituminous coal and stokers there so that not all of the ninety-six boilers are now needed. The installation of horizontal turbines instead of vertical machines was to be expected in view of their size and in the light of recent design, and it is worthy of note that whereas the vertical turbines in the Waterside station operate at a speed of 750 r.p.m., the horizontal turbines in the 201st Street station have a speed of 1800 r.p.m. The water rate of the latter is also less by almost three pounds. The placing of the feed-water pumps in the basement of the turbine room with the turbine auxiliary equipment instead of in the boiler room coupled with the extra room allotted to the apparatus will no doubt show its effect in the saving of labor made possible thereby.

The past history of the United Electric Light & Power Company makes interesting reading. Formed for the express purpose of introducing alternating current in New York City, its growth has been steady despite its early handicaps and the great direct-current system of the New York Edison Company. Were it located in some other borough, away from the hypnotic spell of the well-advertised word Edison, it would be always thought of as one of the great electric companies of the country. Last year it disposed of as much electrical energy was generated by all of the electric-light stations of Rhode Island put together the year before. The company has with much foresight located its station at a strategic point, for the city is constantly growing in its direction, and sites along the waterfront are becoming scarce. Abundant water for condensing purposes is at hand in the Harlem River. The stream being also navigable, shipments of coal by boat can be received at all seasons of the year and at all stages of the tide. Considering all the natural advantages and the types of the units installed, the station from an operating viewpoint should not only be exceptionally easy to handle, but very efficient as well.

Parallel Operation of Transformers

If the grouped transformers have equal transformation ratios and equal reactance factors, then they will divide their load conformably, although not necessarily in proportion to their individual ratings. However, if either the transformation ratios differ or the reactance factors differ, then irregular behavior may be looked for, and some particular transformer may overheat considerably. Theoretically, improvement can be made in the condition by inserting an adjustable impedance into the circuit of the overloaded transformer, but this is a complicated and troublesome procedure that can seldom be resorted to in practice.

In an article of which we publish the first part in this issue Mr. Waldo V. Lyon deals with dissymmetrical parallel operation very thoroughly and in a somewhat novel way. He develops the general formula of the branch current in any one of a parallel group of transformers under an assigned joint load, and then considers the ideal vector components of current that each transformer would carry if all the members of the group were symmetrical and differed only in size. He then finds the local deviation current component in each transformer due to variation in the ratio of transformation, next the deviation component due to variation in reactance factor, and lastly the deviation component due to variation in impedance with respect to rated load. The actual current taken by each transformer is then the ideal current plus its three deviation components. The numerical work of finding the components is simple if the transformation ratios are all alike. When, on the contrary, the transformation ratios differ the numerical work is considerably increased.

It follows from what is indicated in the article that there are certain constants which pertain to a trans-

former and which may become important when the transformer is operated in parallel with others. These constants ought to be stated on the name-plate when the transformer is of any but the smallest sizes. The rated output, frequency, voltages and current are now generally indicated. In addition, it is very desirable that the ratio of transformation at rated load should be added, as well as the numbers of primary and secondary turns; also the short-circuit volts, amperes and apparent power, as measured on the high-tension side with the low-tension winding short-circuited. From such a set of specifications the behavior of any group of transformers operated in parallel could be predicated whenever it might be necessary to compute the probable result. In the absence of these additional data, the behavior of a motley group of parallel transformers is more or less a matter of good luck, and the work required to test the individual transformers in order to deduce the required data may be very troublesome and expensive to obtain.

Additional Anti-Trust Legislation

It is to be expected that the pending anti-trust legislation, based on the message of President Wilson, will be the subject of much discussion. Comments by some of the readers of the *Electrical World* are published elsewhere in this issue. Those who, at our request, have given expression to their opinion naturally touch on the points that seem to them to be the most important. These relate largely to the broad question of regulation of consolidated units. The holding company is discussed by one contributor, the proposed amendment of the Sherman law by another. In the meanwhile the program of the administration is receiving the active consideration of Congress. Already Mr. Brandeis and several others have appeared before committees of the House of Representatives to outline their views. It is to be supposed that after they have had their inning business men who are vitally affected will have a chance to be heard. If a chance is not offered freely, they should take steps to open the way and discuss publicly the effect of new laws upon their internal organization and prosperity.

We have urged this action before. It is urged again because there appears to be a disposition to withhold criticism of administration policies. If these policies are not in the best interest of business and the country, the time when business men should say so is now. If they do not say so, the public will take silence as consent. The country is on the eve of the most important legislation affecting general trade and industry to be enacted since the Sherman law. It has before it the President's general description of what he deems to be the voice and need of business. It has also the definite expression of the message in bills now under consideration in committees of Congress. It is tolerably certain that some legislation will follow. To this legislation business will have to conform. Conformity and prosperity will be better than conformity and disaster. That there may be prosperity it is desirable that the laws shall not roughly upset present reasonable practices. Business men know what these practices are. It is clearly their duty to have a part in the program.

Studies of the Vapor-Tube Lamps

In the Digest this week we publish an abstract of an important paper by Mr. J. Bujes on photometric studies of the Moore vapor-tube lamp made in the laboratory of the Technical High School at Charlottenburg, Germany. The studies were chiefly directed toward the matter of light distribution, of which the original paper contains an exhaustive account. A Moore tube lamp as a whole is difficult to investigate photometrically, since the continuous length is so great that one must work with the photometer far within the distance at which the variations from the inverse square law become embarrassing. One can, of course, dodge the difficulty to a certain extent by taking illumination measurements on the working plane, but in any inclosed space these are so dependent on the nature and position of the bounding surfaces that the results obtained are not easily comparable with those which would be reached under other circumstances. The method followed by Mr. Bujes is probably the most logical one for obtaining definite knowledge of what the tube will do. It consisted of building a temporary photometer room about a section of the tube installed, and then examining suitable elements of the tube to determine the characteristics of the light emission. The emission curve of the element leads to data for the integration of the effect of the radiation over a long tube.

The special characteristic of all tube illuminants is that the light is due to volume radiation instead of surface radiation to an extent which shows very conspicuously in the data of the paper before us. The fact that gaseous illuminants act in this way has, of course, long been well known, since one of the familiar forms of Geissler tube, the so-called "end-on" variety, is constructed with special reference to obtaining high intensity by utilizing volume radiation. The effect of this factor being ascertained, one is in a position to calculate results with some certainty. The nature of the variation due to volume radiation may be readily seen by comparison with a straight incandescent filament. This, being opaque, gives a light intensity which falls off in a perfectly definite way at angles oblique to the axis. A tube light at such angles gets advantage from a greater depth of radiating gas, and a very considerable advantage, in spite of the fact that internal reflections within the tube cut down the available radiation at angles near the axis to considerably below the value which it would theoretically have. The upshot of the work here recorded is that a comparison on the basis of mean hemispherical candle-power is unfair to a tube lamp, only the integrated radiation furnishing a suitable basis for the output.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

Proposed Los Angeles Contract with Power Companies

A draft of the contract with power companies under which the city of Los Angeles proposes to lease, with ultimate right to purchase, the distributing systems of power companies has been completed. The contract has been gone over by a committee of the City Council and approved. It will be submitted to the companies and, if approved, will be reported to the City Council. The next step will be to submit the contract to the vote of the people in March. If the contract is approved, the Railroad Commission of California will be asked to fix the price which the city shall pay for the distributing systems at the end of the lease period of five years.

Taft on Public Ownership

Ex-president William H. Taft at a banquet at the Canadian Club in the King Edward Hotel in Toronto on Jan. 29 sounded a note of warning to the Canadians on public ownership of utilities. His statement was in part as follows: "Let me warn you to act with care in the operation of your great public utilities. Public ownership may be all right; I don't know. But I do know that public operation of the people's needs is a mighty dangerous thing to dabble with. The business of governing bodies and councils is not to operate; their business is to attend to the affairs which concern them, and they have no right to invest sums of money in utilities while more needed things are left in want. Let them who think otherwise try it in a small way," he said, "and let them who would rush ahead do so and then foot the bill, for I warn you again that a high tax rate is not a pleasant platform on which to come before the electorate."

Water-Power Legislation at Albany

The Legislature of New York State will begin this week to plan the State's future policy concerning hydroelectric development. Three bills have been prepared by the Conservation Commission. They are designed to pledge the State to a plan of developing and utilizing as much of its waste water-power as possible and to provide methods for carrying this policy into effect. One bill which carries no appropriation is designed to give the commission power to regulate the flow of rivers and streams by the erection of dams and reservoirs and to vest it with authority to contract with municipalities or public service corporations to supply water-power or electricity for municipal, commercial or irrigation purposes. This measure also would give the commission complete jurisdiction over the surplus waters of the Barge Canal.

To provide for the establishment of experimental plans is the object of the two other bills. The first of these is practically a redraft of the Murtaugh-Patrie bill of last year, which was vetoed by Governor Sulzer. It would locate the first experimental station at Vischer's Ferry, on the canalized portion of the Mohawk River, the electrical energy developed to be sold by the State in the "Capital District." It carries an appropriation of $650,000, of which $282,000 would be made available this year. This bill is understood to have the indorsement of Governor Glynn. The provisions of the remaining measure are identical with the "Capital District" bill, except that it will authorize a hydroelectric plant at any point along the canal and will make available immediately upon its passage $300,000 of a desired appropriation of $700,000.

President Wilson to Outline Policy on Water-Power Control

President Wilson will shortly outline his policy relative to the control of water-powers on navigable streams. There is reason to believe that the policy will be in direct conflict with the views on the question entertained by Mr. Gifford Pinchot and other leading spirits in the American Conservation Association. Democratic leaders in Congress are favorable to state control of water-power sites, the control that Mr. Pinchot alleges means turning them over to the so-called water-power trust.

The President will give his views to Congress on the subject of water-powers either in a special message or in an address to committees that have jurisdiction over this legislation. Members of these committees who have discussed the question with administration leaders predict that when the President makes known his views Mr. Pinchot will begin a warfare like that which was waged on the previous administration. Democratic leaders are strongly opposed to the levying of a federal tax on water-powers and take the position that the authority of the national government over navigable rivers is limited to seeing that the navigability of such streams shall be maintained at all times. They hold that public works which may be erected on these streams are under the law subject to supervision by the states in which they are situated, and this is also stated to be the view of the administration. It has been represented to the administration that material progress in many states has been halted by the failure of Congress to enact general legislation relative to the control of water-powers. For this reason efforts will be made to put a law through this session.

Canadian Municipalities Voice Need of Moderate-Priced Electric Range

Over 150 representatives from Berlin, Waterloo and the counties of Waterloo and Oxford, Ontario, assembled at Berlin on Jan. 30 to discuss Hydro-Electric questions. During the meeting the following resolution was proposed and carried: "That whereas electricity for culinary purposes is safer, more sanitary and in many cases cheaper than artificial gas in Ontario, and would be an attractive feature in the Hydro-

Electric system generally and an especial boon to the farming community and to the towns and villages where gas is not available;

"And whereas the use of electricity for domestic purposes is restricted, because a durable standard type of electric range of moderate cost is not available, and the extensive public service by the Hydro-Electric Power Commission of Ontario would assure a large non-competitive market for a satisfactory electric stove, with a resulting large increase in energy consumption, producing a corresponding reduction in prices;

"Therefore, this meeting of representatives from Oxford and Waterloo Counties begs respectfully to urge upon the commission that it appears highly desirable that the commission should endeavor to develop as soon as possible a satisfactory type of electric range, not leaving the cost of experimental work entirely to private interests, and that as soon as a satisfactory type of range can be produced at moderate cost the commission should manufacture the same for the various municipalities."

Uniform Policies in Making Extensions of Distribution Lines

At the recent meeting of the Wisconsin Electrical Association Mr. W. H. Winslow, then president, brought up the subject of the desirability of uniform practice in making extensions of distribution lines by electric-service companies. Since then the Railroad Commission of Wisconsin has asked the association to make an investigation of the rules followed by all the electrical utilities in the State in relation to the practice adopted in making extensions. The association has expressed its entire willingness to comply with this suggestion and has appointed a committee on uniform policies for electric distribution system extensions and commercial service rules. This committee will conduct an inquiry on the subject and tabulate, or digest, the information received. It consists of Mr. H. G. D. Nutting, Milwaukee, Clement C. Smith properties, chairman; Mr. John St. John, Madison, Madison Gas & Electric Company, and Mr. A. E. Peirce, Eau Clair, Chippewa Valley Railway, Light & Power Company. Mr. Nutting, it will be remembered, presented at the convention an interesting formula which he has devised to be used in considering the advisability of making extensions. In addition to its work in relation to extensions, the committee will endeavor to bring about some uniformity in commercial service rules, such as uniform discount rates, uniform invoice blanks and uniform rules affecting consumers.

Report on Massachusetts Water-Power Conservation

The Massachusetts Commission on Water-Power Conservation has filed its report with the Legislature. The board outlines the absence of complete information upon the use of water-power within the State and recommends a further appropriation to permit exhaustive study of existing conditions, with obligation to report to the next Legislature in January, 1915. It shows the need of defining the responsibilities and privileges of riparian owners in accordance with modern possibilities of storage and regulation of flow; touches upon the rapid development of hydroelectric installations within the State in recent years, and cites the work of the federal government in conjunction with the State of Massachusetts in investigating present conditions, pointing out that the present Harbor and Land Commission, the Geological Survey and other sources are in possession of data which should be assembled under one cover.

The report states that the rising cost of coal makes water-power conservation of great importance to manufacturers, and that the State's policy should be defined as to such developments. The board feels that until further investigation takes place no attempt should be made to decide whether public or private development should be encouraged. It is estimated that several times the developed water-power of 185,996 hp (1909 census) is annually wasted by inadequate conservation of resources. In the year quoted the total power developed in the State for manufacturing was 1,175,071 hp.

Serious Interruption of Ontario Hydro-Electric Service

The electric service of the Hydro-Electric Power Commission of Ontario throughout the Niagara district, extending from Niagara Falls, Ont., to Toronto on the north and to London and St. Thomas on the west, approximately 420 miles of high-tension and 20,000 miles of low-tension lines, was interrupted for nearly eight hours on Saturday, Jan. 31. At about 6 o'clock in the evening a local hurricane swept across the transmission line between Niagara Falls and Dundas in a straight, narrow streak at right angles to the line. The wires were heavily incased in ice owing to a prevailing sleet storm, and thus were also taut and brittle. When the gale struck them two wires snapped and were blown across the others, short-circuiting the line and throwing every city and town in the Municipal Electrical Association's Niagara zone in darkness until nearly 2 o'clock Sunday morning. The greater part of the delay in restoring service was taken up in locating the break, which when finally found involved the stringing of a considerable length of new wire.

The effect in some of the large cities such as Toronto and London was spectacular. The streets of Toronto are lighted exclusively from the Hydro-Electric system, and many thousand homes are also supplied from that system. The interruption, coming on the busiest night of the week, caused great inconvenience. The service of the Toronto Electric Light Company, Ltd., however, was not interrupted, nor were the street railways of Toronto affected, both being supplied with energy from Niagara Falls by the Toronto Power Company, and having auxiliary steam equipment in Toronto. Many of the moving-picture theaters had to close down, and the opera performance in the Royal Alexandra Theater, which depends on Hydro-Electric service exclusively, did not commence until after 9 o'clock, at which time a temporary connection with the system of the Toronto Electric Light Company, Ltd., was made. The civic car lines, of course, were put completely out of business, and residents of the St. Clair, Danforth and Gerrard districts had to walk home through snowdrifts.

Reports from other municipalities indicate that their condition on Saturday night was a duplicate of Toronto's on a smaller scale. Steam reserve plants were put to use in a few cases, but the opera house at Galt had to depend upon the light from candles. The street railway in London was kept going from the company's steam plant, which is still used for part of the supply, and lighting from this source was secured for a performance at the Grand Opera House. The London & Lake Erie Radial Railway, however, was completely demoralized, and passengers from stalled cars were

eventually transported to their destinations by buses sent out for them in the middle of the night. London residents who sought to buy candles were confronted with the fact that all grocery stores were closed at 7 o'clock under a new by-law.

Commenting on the mishap, the Hon. Adam Beck, chairman of the Hydro-Electric Power Commission, said on Feb. 1 that a second line has been surveyed between Dundas and Niagara Falls, which is 6 miles shorter than the present one. This will be constructed at once, and there will then be four circuits to Dundas instead of two, as at present. The additional lines will be of extra heavy aluminum, reinforced by steel. The present line from Dundas to London and St. Thomas will be duplicated with the new extra-heavy aluminum conductor which is to be used also on the extension to Chatham and Windsor.

Comments on the President's Message

At the request of the *Electrical World*, the following expressions of opinion on the message of President Wilson on anti-trust legislation have been given:

Mr. Hugo Reisinger: "The message of President Wilson of Jan. 20, regarding trusts and monopolies, has my full approval. Of course, a satisfactory settlement is a difficult and intricate matter, and I am afraid the whole question will never be solved satisfactorily because the trusts will always find, through advice of their eminent lawyers, ways and means to get around the law. In my mind the trust question can only be solved to the entire satisfaction of the people if the articles which the trusts manufacture and control are put on the free list, because the high duty which we had, and which to a great extent we still suffer under, has created the trusts and kept them for the last sixteen years in a flourishing condition. I know what I am talking about, because I have been fighting a trust for years, and notwithstanding that I proved before the committee on ways and means that the article in question can be manufactured here as cheap as abroad, or perhaps cheaper, and the trust even admitted that it had a monopoly of the business, it is still protected by a duty of from 30 per cent to 40 per cent. I am an admirer of President Wilson and of Mr. Underwood, and if they have not succeeded in reducing the tariff to the proper level, it was not their fault."

Mr. W. S. Barstow, W. S. Barstow & Company: "In asking me for my views on the message presented to Congress by President Wilson on Jan. 20, I presume you mean in this connection that part of the message referring to holding companies and interlocking directorates. A careful consideration of the subject convinces me that this part of the message does not apply to purely security holding companies interested in the securities of public utility properties, where such public utility properties are far apart in different states and where the holding company is simply used as a means of equalizing the risks of investment for small holders and the securing of expert management and economical financing as applied to the operating companies themselves. At the present time almost all of the operating companies are under the jurisdiction of public service commissions in the various states, and through these commissions the public, as well as the investor, is protected."

Mr. Arthur Williams, New York Edison Company: "It would be difficult, I find, to express an opinion upon the message of President Wilson. The effect upon myself was very favorable. One of the unfortunate features of some of our regulatory laws is their indefiniteness, through which industry is subjected to vagaries in the mental attitude of those temporarily in power. Fair laws, drawn with reasonable definiteness, will cure a great deal of the uncertainty and unrest of the past."

Mr. W. N. Matthews, W. N. Matthews & Brother: "I believe that the last message of our President dealt with some very important matters in such a delicate way as to inspire the confidence of all who read it."

Mr. J. J. Sullivan, president American Railways Company: "As the President has made a new departure in speaking directly to Congress on subjects which he deems of pressing importance, I believe that it is the duty of all good citizens to lend him their unequivocal support. When he asserts that no one who obeys the laws need fear we must not be afraid, for we all desire to uphold and maintain justice and the supremacy of the Constitution of the United States and all the laws made in conformity therewith. I believe that the turning point has come in the industrial conditions, when improved business will result from the renewed endeavor, initiative and enterprise of the American people unhampered by useless and confusing laws."

Mr. H. Ward Leonard: "As regards the suggestion that the Sherman law be accurately defined by amendment, I think this more likely to weaken its benecial effect than to strengthen it. As illustrative of this I direct attention to the fact that the bill recently introduced to accomplish this definition of the Sherman law does not seem to embrace within its scope such a contract as that which resulted in the board of patent control of the General Electric and Westinghouse companies, which was disbanded not long ago after fifteen years of existence. Under the Sherman law as it now exists such a contract would probably be held to be illegal, while it apparently could not be held to be illegal under the exact but incomplete definition of the Sherman law which is contained in the said bill. Those who drafted the Sherman law intentionally and wisely left to the courts the definition of its scope, and in my opinion any attempt to define accurately by numerous amendments the precise scope of the Sherman law will merely result in sanctioning contracts deliberately intended to restrain trade but ingeniously drafted so as to run the gantlet of exact but inadequate definitions."

Government Ownership of Telephone Lines

Postmaster-General Burleson submitted to the Senate on Jan. 31 a report dealing with the subject of government ownership of telegraph and telephone lines. The report was prepared by a committee of officials of the Post Office Department in compliance with a resolution of the Senate requesting information on this subject. Mr. Burleson did not comment upon the matter in submitting the report of the committee.

The committee recommends a government monopoly of telegraph, telephone and radio communications and such other means for the transmission of intelligence as may develop hereafter. It would have Congress acquire by purchase at appraised value the commercial telephone lines with the exception of the farmers' lines. Its recommendation is that Congress authorize the Postmaster-General to issue in his discretion and under such regulation as he may prescribe revocable licenses for the operation by private individuals, associations, companies and corporations of the telegraph service and such parts of the telephone service as may not be acquired by the government.

The committee says that there is an advantage in economy in the merger of post offices and telephone stations. It shows that the capitalization of the entire

telephone system of the country is approximately $900,000,000, but suggests that the appraised value of the properties would fall considerably short of this amount. The committee definitely recommends the acquisition of the telephone lines without the telegraph system, holding that the expense of equipping the telephone system for telegraphy would involve only the cost of the instruments and would therefore be negligible. It declares that the acquisition of the telegraph service of the country would necessitate taking over the duplicate plants of two companies controlling this service with duplicate expenses of maintenance.

Mr. F. H. Bethel, vice-president New York Telephone Company, made a statement in which he said the report of the committee was principally remarkable for the lack of knowledge displayed of conditions both here and abroad.

Architects and Illuminating Engineers in Joint Session

At a joint meeting of the Chicago Section of the Illuminating Engineering Society and the Chicago Architects' Business Men's Association, Jan. 27, Mr. J. B. Jackson, one of the engineers of the Commonwealth Edison Company, presented a paper entitled "Planning Lighting Installations," the purpose of which was to assist architects in laying out lighting plans for buildings. Mr. W. A. Durgin gave one of his short talks in the series relating to the fundamentals of illumination. By means of ingeniously constructed models he pointed out to the architects what they should know in order that they might understand the language of the illuminating engineer.

In his paper Mr. Jackson explained why it is more satisfactory to plan lighting installations before buildings are erected than to wait until they are completed. He then showed a method by which the necessary data for any class of building can be worked out. In connection with this method four tables were presented to the members in blueprint form giving data concerning the characteristics of incandescent lamps now on the market; foot-candle intensities recommended for various classes of service; desirable sizes of bays for different types of rooms, and the necessary watts per square foot in buildings of different finishes with various types of reflectors in order to produce 1 ft.-candle illumination. Examples were worked out in the paper, and the tables themselves were presented in such a way as to be of practical value to the architect.

During the discussion of the paper Mr. A. J. Sweet, Milwaukee, said that one of the ideals of the illuminating engineer of to-day is to reduce the eye strain which is one cause of the increase in ocular trouble in the United States at present. The speaker also told of the work of the committee of the Illuminating Engineering Society which is devoting much time to remedying conditions that produce eye strain.

Hearing on Anti-Trust Legislation

The committee on interstate and foreign commerce of the House of Representatives began hearings on Jan. 30 on the bill providing for an interstate trade commission. The judiciary committee of the House has begun hearings on other bills comprised in the anti-trust legislation program of the administration.

Mr. Louis D. Brandeis testified in favor of the proposed trade commission, and said that it should be vested with power to prescribe a system of accounting for interstate corporations and to compel publicity. He suggested that this be done by methods similar to those followed by the Interstate Commerce Commission for carriers. With a total of 305,000 corporations in the country, Mr. Brandeis did not expect that uniformity in accounting would be adopted at once. He thought, however, that it would be possible to require like methods of accounting for like kinds of business and corporations.

Representative Stanley, of Kentucky, who appeared before the judiciary committee of the House, argued that corporate forces had waged a campaign for more than a decade for the interpolation by construction into the Sherman law of "unreasonable" as applied to restraint of trade. He argued that Congress should wipe that construction out of the law by express statute.

Mr. Felix H. Levy, of New York, of counsel for the government in the tobacco case, in testifying on Feb. 3 opposed the section of the trade relations bill which proposes to prohibit so-called exclusive selling agency contracts, and said that this would be a dangerous proposition for the business world. This section would overthrow a long line of court decisions approving selling agencies where no element of combination in restraint of trade was present. The prohibition, if included in the bill, should be restricted to concerns engaged in monopoly.

Mr. Seth Low, of New York, president National Civic Federation, submitted a tentative draft of an interstate trade commission bill. He declared that the bill pending before the committee would give a commission too drastic power of search of corporations.

Government Radio Supervision

In order to insure the use of adequate wireless telegraph apparatus for emergency, as well as regular, service on shipboard, the United States Department of Commerce now refuses to permit steamships with defective radio apparatus to leave United States ports. In accordance with this policy, the S. S. *Cedric* was boarded by United States Radio Inspector R. H. Marriott shortly before she was due to sail from New York on Jan. 29. The auxiliary radio transmitter, which consisted of a "ten-inch" hammer break induction coil operated from storage cells, was found not to be in operating condition. After a repair to the ground lead was made the coil sparked satisfactorily, but then the hard-rubber roof insulator leading from the operating room caught fire and had to be replaced. In order not to delay the ship further, Inspector Marriott agreed to remain aboard as she passed down the bay, expecting that the necessary repairs might be completed before Staten Island was reached. Even with the new insulator installed, however, it was not possible to get a spark on the auxiliary set. An entire outfit of antenna insulators was therefore brought out on a tug by the Marconi Wireless Telegraph Company's inspector. Before these arrived at about 2:30 p. m. the operator had succeeded in getting the set working, so that it was then passed by the United States inspector. It appeared that the defective operation of the auxiliary was attributable to leakage through damp aerial insulators and that after these were dried (by sunlight and leakage currents) signaling was possible. The new set of insulators was kept aboard by the *Cedric*, nevertheless.

The S. S. *Majestic*, sailing on Jan. 30, had somewhat similar trouble. During an inspection by Mr. Marriott on Jan. 29 the auxiliary transmitter set fire to the roof insulator, which thereupon had to be renewed. On Jan. 30, about half an hour before sailing time, it was found that the induction coil would not produce a spark at all.

As in the *Cedric's* case, the United States inspector agreed to go as far out as Staten Island with the ship and to allow her to proceed from there if the coil were in repair by that time. After some labor and readjustment the operator succeeded in getting the set to spark, and the new roof insulator appeared to hold, so that the inspector was able to "pass" the equipment.

Co-operation by Individuals

Mr. Martin J. Wolf, of Chicago, statesman-at-large for the Jovian Order, gave a talk on "Co-operation" at the luncheon of the Chicago Jovian League on Feb. 2. Mr. Wolf showed that under modern conditions of industry the old adage that "Competition is the life of trade" is no longer strictly true. It might be true of what has been termed "benevolent competition," but actually, under present-day conditions, co-operation tends toward greater efficiency. Co-operation is a matter for each individual to take home to himself. He must co-operate for the other fellow as well as in his own interests, remembering that one cannot get more out of co-operation than he puts into it. In the electrical industry probably the central station must be regarded as the basis on which all other departments are to build. No one department of the industry nor one individual in it is independent of the others. The trouble is that all want restricted competition in selling and unrestricted competition in buying. This very human tendency must be combated. Mr. Wolf pointed out also that the central-station companies advocate regulated monopoly in selling their product, but when they come to buy machinery or supplies they are apt to want unrestricted competition. He thought perhaps there might be some inconsistency here. Co-operation is really the result of a natural law of human society. When a salesman says that he "pulled all the strings" he knew of to close a certain transaction, the statement means simply that he availed himself of the benefits of co-operation. One man cannot accomplish anything worth while and do it alone. The sum total of concerted activity toward a given end is what is called co-operation. In other words, co-operation is utilizing the efficiency of numbers. It is a true note in that modern harmony which means efficiency.

California Investigations of Inductive Interference

Since its last progress report, summarized in the *Electrical World* of Oct. 11, 1913, page 733, the joint committee on inductive interference, authorized by the California State Railroad Commission, has prepared some thirty technical reports on results obtained from studies of the parallels between transmission and telephone lines described in that issue. Some of the conclusions reached are as follows:

The fundamental sixty-cycle wave of voltage or current is of relatively little importance in the production of noise in telephone circuits. It becomes of importance, however, if it gives rise to longitudinal voltages of sufficient magnitude to constitute a physical hazard, to interfere with the operation of grounded signaling devices or superimposed telegraph service, or to operate protective apparatus on the circuits.

Harmonic Frequencies Cause of Noise

The harmonics of the voltage and current waves are of chief interest as the cause of noise in telephone circuits, particularly the higher harmonics or those within the range of the voice frequencies. The fundamental and lower harmonics are important as disturbing factors in telegraph circuits.

The above facts show clearly the great desirability, from the standpoint of inductive interference, of having wave-forms of voltage and current in power circuits free from all harmonics. That such a condition does not obtain in the present state of the art is a basic cause of the disturbance to communication circuits paralleled by power circuits. Furthermore, the above facts emphasize the desirability that designers and manufacturers eliminate, as far as practicable, those features of design favorable to distorted wave-forms.

Balanced and Residual Components

In order to facilitate the analysis of the inductive effects of a power circuit on parallel communication circuits, the voltages and currents of a three-phase power system can be conveniently regarded as made up of components which exhibit distinct characteristics and can be treated separately. In any three-phase system in which the three voltages between pairs of wires are equal in magnitude, the voltage between any wire and ground can be considered to be the vector sum of two voltages which are called the balanced and the residual components respectively. The balanced components consist of three equal voltages between the three wires and ground, the vector sum of which is zero. The residual components consist of three equal voltages between wires and ground which are in phase with each other.

The residual voltage of the system is defined as the vector sum of the voltages of the three conductors to ground. It is, therefore, three times the residual voltage of the individual conductors or three times the equivalent single-phase voltage of the three conductors in parallel with respect to the earth. The currents flowing in the three wires of a three-phase circuit may be considered to be composed of three sets of currents, namely: (1) balanced components consisting of equal currents in each of the three line wires whose vector sum is zero; (2) a single-phase current flowing in a loop composed of two of the wires; (3) a residual current divided equally between the three wires and returning through the earth. Residual current is defined as the vector sum of the three line currents and is, therefore, the equivalent single-phase current flowing through the three line conductors in parallel with the earth completing the circuit.

Longitudinal and Transverse Induction Phenomena

For the purpose of clearness it is convenient to classify induction phenomena as longitudinal or transverse, referring to their manifestations on a metallic circuit. Longitudinal induced voltage refers to the voltage induced between the circuit and ground in the case of electrostatic induction and along the circuit between the two ends of the exposure in the case of electromagnetic induction. The transverse induced voltage of a circuit is the difference between the longitudinal induced voltage of the sides of the circuit. In the case of electrostatic induction this voltage acts between the two sides of the circuit, and in the case of electromagnetic induction it acts around the metallic circuit.

It has been found in the case of the power lines investigated that the fundamental fifth, seventh and eleventh harmonics are prominent in the balanced currents and voltages, while the fundamental third and ninth harmonics are prominent in the residual currents and voltages of the power system.

By a comparison of the prominent harmonics in the currents and voltages of the power system with those of the induction in the telephone circuits it is evident that the longitudinal induction arises principally from the residual voltages and currents, while the trans-

verse induction shows principally the characteristics of the balanced voltages and currents together with some effect from the residual voltage and current.

Calculation of Image-Conductor Positions

In computations of electromagnetic induction, experience has indicated that the distances between wires and their images cannot be assumed to be twice the height of the wires above the ground. Special tests carried out to determine the equivalent depth of the image conductors indicated this depth to be approximately 300 meters below the earth's surface. Owing to the electrostatic shielding effect of neighboring objects, it was found, also, that the computed electrostatic induction was greater than that actually observed, indicating that in effect the ground surface was brought nearer to the conductors. Electrostatic shielding of the circuits under test, by grounding other circuits on the telephone lead at one point, reduced the electrostatic induction, particularly the longitudinal induction.

The field engineering staff of the committee is now at Santa Cruz, where it is investigating the subject of transpositions on the 17-mile parallel between the 22,000-volt, three-phase line of the Coast Counties Gas & Electric Company and a toll lead of the Pacific Telephone & Telegraph Company.

Meeting of New Jersey Electrical Contractors

One of the most successful meetings ever held by the New Jersey Electrical Contractors' Association took place at the Ridgeway Hotel, Camden, N. J., Jan. 24. In his presidential address Mr. E. P. Strang, of the Strang Electric Company, said that the electrical contractor of to-day is not the electrical contractor of the past, who had his office in his hat, and every time his hat blew off changed his place of business. Men of the latter type, he said, made it hard for the legitimate contractor to do business on business principles. He extolled the benefits to be derived from membership in the National Electrical Contractors' Association and voiced the necessity of closer co-operation between the contractors themselves. After the routine business was disposed of, Mr. A. H. Moses addressed the meeting on the subject of "The Architect and the Electrical Contractor." "We are all dependent upon one another," said Mr. Moses, "and each branch of work, whatever it may be, must help in the great general work of co-operation. Contractors should, therefore, strive to be fair and just in estimating and in doing good work so as to win the confidence of all those with whom they come in contact. In this way friendly and beneficial relationships will be formed."

After Mr. Moses' address a recess was declared and the manufacturers and jobbers were admitted to the session. Mr. E. Ward Wilkins, of the Partrick, Carter & Wilkins Company, Philadelphia, Pa., made a very interesting talk on conditions in the trade as they were and as they are. Mr. J. P. Alexander, of the General Electric Company, described the equipment of a Trenton pottery, and after a number of other manufacturers and jobbers had spoken upon the good the New Jersey Electrical Contractors' Association was doing, Mr. Farley Osgood, of the Public Service Electric Company of New Jersey, made an interesting talk upon the relation of the Public Service Electric Company of New Jersey toward the electrical contractors. Mr. Osgood was followed by Messrs. Vanderpoole, Sawin, Pemberton, Harberson, Cox and Young, all of the Public Service Electric Company. Others who took part in the proceedings were Mr. Gaffrey, of the Municipal Underwriters, who talked upon municipal inspection; Mr. Dorris, of the Underwriters of the Middle Department, who spoke of the relation of the inspector toward the electrical contractor, and Mr. J. W. Kelley, chief of the Electrical Bureau of Camden, N. J., who explained the law requiring the licensing of contractors there.

A banquet was given in the evening after which the following officers were elected: President, Mr. E. P. Strang, of Camden; vice-president, Mr. Charles Newman, of Passaic; secretary, Mr. J. Van Dyke, of Asbury Park; treasurer, Mr. P. H. Jaehnig, of Newark. The board of directors comprises Messrs. J. T. Plaskett, of Merchantville; S. H. Smith, of Trenton; Carl F. Adams, of Trenton; R. P. Ward, of Dover, and R. McGown, of Newark, N. J. The next semi-annual meeting of the association will be held at Long Branch, N. J.

Storage-Battery Wood-Separator Patent Upheld

Judge Thompson of the United States Court for the Eastern District of Pennsylvania handed down on Jan. 27 an opinion upholding the validity of United States Patent No. 1,000,330, relating to wood storage-battery separators, issued to Mr. Norman Dodge Aug. 3, 1911, and assigned by him to the Electric Storage Battery Company, of Philadelphia, in the suit brought by the latter company against the Philadelphia Storage Battery Company. The patent in question relates to the treatment of wood separators to remove the acetic-acid-forming constituents of the wood, which deleteriously attack the positive plate, while retaining such constituents as beneficially affect the negative plate. The defendant contested the validity of the patent on the grounds of prior invention and state of the art, and also denied infringement, claiming that neither of its processes of soaking the wood in a sulphuric-acid-water solution or in a 3 per cent solution of caustic potash was specifically mentioned in the patent, which employs, however, the term "alkaline solution." The judge ruled that where an unpatented device the existence and use of which are proved only by oral testimony is set up in complete anticipation of a patent the proof sustaining it must be clear, satisfactory and beyond a reasonable doubt, but held that in the present case the defendant had not sustained the burden of proof to overthrow the presumption of validity of the complainant's patent.

Depreciation as Affecting Valuation and Fair Return

A discussion on the paper by Mr. John W. Alvord on "The Depreciation of Public Utility Properties as Affecting Their Valuation and Fair Return," presented before the American Society of Civil Engineers, is published in the January *Proceedings* of the society.

Mr. W. J. Wilgus says that whether or not a depreciation fund is actually set aside would seem to be immaterial. What the public is interested in is the proper upkeep of the property without an increase for that purpose of the capital burden which it is expected to bear through the rate.

Mr. J. E. Willoughby says that the method of penalizing the owner suggested by Mr. Alvord—the deduction of the accrued depreciation from the reproduction cost new—is a confiscation of property to the amount of the accrued depreciation because the amount of the accrued depreciation was originally and necessarily put into the property before any depreciation could take place, and whatever has taken place is properly to be regarded as an expense of operation.

Mr. Frank C. Boes said that one cannot expect to deduct $3,000 from a ten-thousand-dollar plant in fixing rates and still have a ten-thousand-dollar service main-

tained. Does one pay less for milk given by old cows or for apples grown on old trees?

Mr. Allen Hazen said that it is clearly the privilege and duty of public service corporations to charge rates that will permit marking off a proper allowance for depreciation. When this allowance has been once determined and marked off there would seem to be no equitable reason why the capital thus marked off should be further considered in connection with the question of fair rates.

Mr. H. C. Vensano said that the whole question as to whether or not depreciation should be deducted from physical valuations for rate-making purposes would seem to be largely a matter as to whether or not the public utility had been handled correctly. It would seem that no theory of any kind can be made to apply to a property which has not been handled reasonably and honestly by its management and at the same time be made to apply equally to a well-managed property.

Mr. William B. Jackson believes that undue importance is placed on depreciation of plant *per se* without due consideration being given to the question whether the property has been kept in such condition as to give substantially as good and economical service as a new property and is fully safeguarded by its reserves from financial breakdown.

Mr. Henry Floy said that where a corporation is created and the money of owners is invested, after notice, under conditions prescribed in advance by regulating bodies, there can be no fair or honest objection to the insistence on accumulation of depreciation funds out of revenue and the use of such funds in any reasonable way, but they cannot necessarily be used as a measure of the value of the property on which rates are to be fixed. With respect to corporations that have been in existence for a considerable period of time without commission regulation and have been following certain generally accepted principles with the consent, more or less definite, of public authorities, Mr. Floy takes emphatic exception to the proposition advanced by Mr. Alvord that value for rate-fixing purposes must be determined by deducting the amount of a computed but not accumulated reserve fund from the cost of reproduction new.

Contributions to the discussion were also made by Messrs. Leonard Metcalf, F. Lavis, Clinton S. Burns, Stuart K. Knox and J. H. Gandolfo and Dr. Alexander C. Humphreys.

Proposed Electrification of Los Angeles & San Diego Beach Railway

The Railroad Commission of California has rendered a decision under which the Los Angeles & San Diego Beach Railway Company is to make application for extension of its franchise, agreeing, if the extension is granted, to apply for permission to issue bonds. The proceeds of the bonds shall be used to electrify the road and provide better service.

The company now operates with steam trains and gasoline motor cars. Testimony showed that the steam trains were generally on time and that but few delays greater than five minutes occurred, but the gasoline motor cars were a source of great annoyance and had frequent breakdowns. The company stated that it had endeavored to obtain electric storage-battery cars to be used to replace the steam equipment and the gasoline motor-car equipment, but that after negotiation with two electric storage-battery car companies the matter was dropped for the reason that the manufacturers could not guarantee the operation of cars built under and to comply with the company's specifications.

The General Electric Company and the Westinghouse Electric & Manufacturing Company have made estimates as to the cost of electrifying the line. The estimate is approximately $300,000. The City Council of San Diego has been unwilling to grant the franchises desired unless electrification is promised. The commission took occasion to investigate as to the probable ability of the company to pay bond interest from the operation of the road on an amount sufficient to electrify. From the testimony introduced Mr. H. D. Loveland, the commissioner who wrote the decision, is of the opinion that the operation of the road would easily pay interest at ordinary rates on an issue of bonds sufficient to electrify.

Midyear Meeting of American Electric Railway Association

The midyear conference of the American Electric Railway Association was held at the headquarters in New York on Jan. 29 and 30.

One of the principal addresses, which was made at the annual dinner of the association, was by Mr. Guy E. Tripp, chairman of the board of directors Westinghouse Electric & Manufacturing Company. Mr. Tripp spoke on "Public Relations." He advocated co-operation with the public. He does not mean co-operation with the self-appointed advisers of the people who fill the magazines with misstatements of facts and upon such premises build their arguments. "For example," said Mr. Tripp, "take the misstatement by Mr. Brandeis in *Harper's Weekly* that the Westinghouse Electric & Manufacturing Company and the General Electric Company are only alleged competitors. If all his facts are as false as that one (and I know that one to be false), his conclusions are worthless."

Mr. Tripp added that public service corporations now understand that regulation and competition are the only alternatives lying between unrestrained operation for private profit and government ownership. They have also learned that regulation is better than competition. Mr. Tripp also believes that the people understand that regulated private ownership is a great deal better than government ownership. Public service securities ought to be a favored and preferred investment, and he believes they will be so when public confidence has been secured.

Mr. Tripp also took up the subject of holding companies. He said: "That those in control of these centralized organizations should so conduct their business that no injury will result either to the public service industry or other business interests is a principle the importance of which cannot be overestimated. For example, the support and approval of my company and its stockholders cannot be expected in those cases where centralized control results in a door closed to our fair competition and a serious loss to us."

Mr. Henry W. Anderson, vice-president Virginia Railway & Power Company, made an address at the annual dinner on "The Relations of Public Service Companies and the Public."

At the conference on Jan. 30 a report of the joint committee on joint use of poles was approved. The committee reported that it had received various comments and criticisms from member companies on the report presented at the 1913 convention. The Pennsylvania Street Railway Association sent in a general protest against the form of agreement. The committee will meet again about Feb. 18 and will analyze the suggestions and make such revisions as in its judgment are advisable, and these will be placed in the hands of member companies and others interested not later than

May 1. The committee will meet again in July so as to prepare a final report for submission to the 1914 convention.

Mr. Halford Erickson, of the Railroad Commission of Wisconsin, read a paper on "The Economic Aspect of Regulation Compared with Profit-Sharing with the Municipality." Mr. Erickson strongly favors regulation.

Mr. C. L. S. Tingley, vice-president American Railways Company, read a paper on "Present-Day Influence of Labor on Legislation."

At a meeting of the committee on public relations a sub-committee was appointed to draft a platform of principles on questions of public policy for the association, to outline a plan of educational publicity and to prepare a plan for raising a publicity fund of $50,000 or more. The members of the sub-committee are Messrs. James H. McGraw, chairman; Guy E. Tripp, C. Loomis Allen and Frank R. Ford and Col. T. S. Williams. Mr. Thomas N. McCarter, chairman of the committee on public relations, is ex officio a member of the sub-committee.

The American Museum of Safety informed the association that a gold medal with silver and bronze replica, in memory of Anthony N. Brady, will be granted annually to the American electric railway which does the most to promote safety of service.

Annual Meeting of the Western Association of Electrical Inspectors

In last week's issue was published an account of the first two days' sessions of the ninth annual convention of the Western Association of Electrical Inspectors held in the new Hotel Gibson, Cincinnati, Jan. 27-29.

At the concluding sessions on Jan. 29 reports were presented by the following standing committees: "Installation and Operation of Induction Motors," by Mr. K. W. Adkins, of Kansas City; "Architects' Specifications," by Mr. F. H. Moore, of Indianapolis; "Signal Systems," by Mr. F. S. Anderson, and "Rubber-Covered Wire," by Mr. V. H. Tousley, of Chicago.

Installation and Operation of Induction Motors

Mr. Adkins spoke of the difficulty of choosing wiring tables which covered satisfactorily the necessary sizes of motor leads for motors of various speeds, voltages, sizes and load connected at starting. He presented tables giving the sizes of motor leads and sizes of starting fuses under these varying conditions, in the determination of which the time element of the fuse and the usual conditions of acceleration were taken into consideration. The time element somewhat reduces the size of fuse necessary for motors in which the starting current is quickly reduced.

Discussion

In the discussion which followed the reading of the paper Mr. F. A. Barron, of the General Electric Company, described some exhaustive tests made recently at the Schenectady research laboratories, where motors of different sizes were started some fifty times with fuses so chosen as just to fail of blowing. Curves were plotted showing that, other conditions remaining the same, the amount of overfusing necessary varies from about four times the rated motor current in 1-hp sizes to about twice the current in large sizes. While high-speed motors take a somewhat greater initial current, the longer duration of starting in the case of slow-speed motors necessitates the use of fuses of about the same size as in the case of the high-speed motors.

The discussion further brought out the fact that automatic non-fusible cut-outs are desirable at lower current-carrying capacities than are now generally permitted by the National Electrical Code, for reasons of economy and convenience as well as of safety to property and life. The recommendations of the committee were summarized as follows: All induction motors of 5 hp and over should be provided with approved starting devices. Each alternating-current motor of ¼ hp or over should be provided with separate fuse protection. Proper rated running fuses should be installed on all motors of 1 hp and over. An approved auto starter will be accepted in lieu of switches as required by the rules, provided the switches of the auto-starters disconnect all the wires running to the motors. Motors without compensators must be started by means of an approved double-throw switch provided with spring releases on the starting side, so that it will remain in its starting position only when held there. In classes of service where fuse protection is of secondary importance the committee recommends the installation of motors especially designed for heavy overloads, and that the leads to such motors be of sufficient size to be properly protected by the required fuses. If induction motors of the squirrel-cage type are used in this class of service, heavy conductors are required in addition to approved starting devices equipped with overload release, no-voltage release and circuit-breakers equipped with time-element devices. The committee also recommends that motor manufacturers place on the nameplate of polyphase motors of the slip-ring type the ratio of transformation existing between the stator and rotor currents.

Architects' Specifications

Mr. F. M. Moore, in his report for the committee on architects' specifications, gave an outline of wiring features which should be covered, and offered suggestions as to the scope of a desirable specification and of each section. He emphasized the necessity of personal relationships between the electrical inspector and architect.

Rubber-Covered Wire

Mr. Victor H. Tousley in his report drew attention to the fact that there still is a lot of old-code rubber-covered wire on the market, and that cheap contractors are urged by energetic salesmen to buy this material of inferior insulation, the main consideration being the extra discounts. He said that, from his experience in Chicago, the principal offenders are among the fixture supply dealers and manufacturers, especially the makers of portable lamps. One cause for the use of the inferior old-code wire is the great competition among the smaller, or what are commonly known as the grip-sack contractors. This competition is greatest in the smaller sizes of wire, for this is the most in demand and the least capital and equipment are required for its installation. He attributed the wide use of defective wire to the fact that the Underwriters' factory inspection service is not clothed with sufficient authority. He maintained that the laboratory inspector at the factory should be allowed to test the entire product instead of only a portion of the product, and should also have authority to demand the destruction of all wire not coming up to the specifications. He recommended that the Underwriters' Laboratories refuse label service to any factory manufacturing old wire, and that coils not supplied with a genuine factory inspection tag should not be accepted by wiremen. He condemned strongly the imposition on the public of insulation dangerous to life and to property.

Discussion

Much discussion greeted the report, and a statement of the position assumed by the Underwriters' Laboratories toward the manufacture of inferior rubber-insulated wire was made by Mr. A. G. Latta, of Chicago.

Mr. Latta called attention to some of the difficulties surrounding the enforcement of some of the recommendations of Mr. Tousley, and said that the Underwriters' Laboratories are doing all that they consistently can to stop the sale of the old-code product and welcome any suggestions as to how their efforts can be made more effective. A simple test to apply on wire suspected of not being up to the new-code standard is the so-called stretch test on the rubber insulation. He asked for the laboratories the earnest co-operation of every electrical inspector in the field, assuring them of every assistance in the promotion of safe electrical wiring.

Election of Officers

On the recommendation of the nominating committee the following officers were chosen for 1914-1915: Mr. B. W. Clarke, of Detroit, president; Mr. H. M. Maxwell, first vice-president; Mr. F. H. Moore, of Indianapolis, second vice-president, and Mr. H. B. Long, chairman of the executive committee.

On Jan. 30 the members of the association were taken in automobiles to the Cincinnati Water Works and to the Cincinnati Car Works. The delegates were afterward the guests of Mr. G. W. Cleveland, manager of the Cincinnati Fire Prevention Bureau, at a luncheon in the Business Men's Club.

On the whole, the work of the convention was unusually well planned, and the continuance of standing committees appeared to bring very useful results. There was a large attendance of manufacturing and central-station men, to whom the discussion was at all times open, and there was a noticeable spirit of co-operation for the betterment of the whole industry.

Public Service Commission News

Vermont Commission

Counsel for the New England Telephone & Telegraph Company have filed a brief with the Public Service Commission demurring to the proposed reduction in telephone rates. The commission has been investigating the company's tariffs since last summer, and the board was reorganized by Governor Fletcher on account of the refusal of the former members to consider the question. The company contends that reduction in rates at the present time would be unjust and confiscatory, that no evidence has been taken to show that the present rates are unreasonable, and that the proposed schedule would wipe out the present small margin of profit of the five companies, with resultant crippling of the service. A decision is expected about March 1.

California Commission

The Railroad Commission of California has authorized the Pitt River Power Company to issue $90,000 preferred stock, of which $30,000 will be used in payment for a hydroelectric site and $60,000 to cover the cost of construction of a hydroelectric plant. The latter amount of stock is to be issued only after the company has filed and has had approved a detailed statement of proposed construction expenditures.

The company now has an authorized capital stock of $500,000, of which $132,500 is preferred. The $30,000 of preferred stock is to be given to J. H. Logan in exchange for property on which Burney Falls is situated, which is to be the site for the power plant. The property to be transferred is described as consisting of certain land and the water rights incident thereto. In granting the application the commission states that it must not be understood as finding that the value of the property to be transferred amounts to $30,000. Neither must the commission be understood as placing any value upon whatever water rights are transferred to the company.

Ohio Commission

The Public Service Commission of Ohio has asked for an appropriation sufficient to enable it to make appraisals of utilities. The commission mentioned specially in this connection the telephone companies in Cleveland, the Cincinnati Traction Company, and the Bucyrus Light & Power Company.

New Jersey Commission

The Board of Public Utility Commissioners of New Jersey has handed down a decision dismissing the petition of the Jersey Power Company for authority to issue $75,000 stock, the proceeds to be used for the construction of transmission lines in Morris County. The board says that the evidence shows that the company intended to obtain its power from the Jersey Corporation at Boonton, the latter organization not being a public utility, and further that the controlling interests in both companies are to a large extent the same. The board holds that the desire to use the proceeds of this stock as shown is one that lends itself to the purpose of those who might be bent on escaping the control which the law of the State seeks to throw around public utilities generally, and that where the generating company is not a public utility, and therefore is exempt from the regulation designed for such, and when the electric energy transmitted by the transmission company is generated by a concern not under public regulation and control, the board cannot exercise the power conferred upon it by statute.

Indiana Commission

The Public Service Commission of Indiana, by its approval of an issue of $850,000 bonds by the Richmond Light, Heat & Power Company, aroused comment at Richmond. Opponents of the company there contend that the commission has in reality established a new valuation for the plant.

The commission is expected to approve a new date schedule, filed recently by the Indianapolis Telephone Company for four-party lines. The new rate for this class of subscribers is to be $15 annually. The status of the plan to merge the Central Union Telephone Company holdings in Indianapolis with those of the Indianapolis company remains unchanged, since the commission announced that it probably would be more than a year before the question could be taken up.

The commission has sent out warnings to utilities against the purchase of accounting systems from agents. The commission has supplied electric light, gas and water companies with forms for accounting systems, and forms will be prepared soon for use by heating and telephone plants. The commission has been told that agents have been attempting to sell forms which do not have its approval.

The death of an employee of the Cincinnati, Hamilton & Dayton Railroad in Indianapolis during a terrific sleet storm, which broke many wires and is believed to have caused a trolley wire to fall across a railroad telephone wire, has inspired the commission to begin an investigation of the possibilities of better insulation for telephone systems. The employee was killed when telephoning from one of the booths kept for the use of trainmen on the railroad. Commissioner Payne immediately notified officials of the road and electrical experts in Indianapolis that he would conduct a hearing to ascertain whether more perfect insulation and better protection from falling wires might be secured, at least on the telephone systems of railroads.

The sleet storm in the last few days of January caused thousands of dollars of damage to utility com-

panies throughout Indiana. In Indianapolis the Central Union Telephone Company reported 500 poles down. The commission in several instances received requests to assist the companies in restoring service.

Massachusetts Commission

The Public Service Commission of Massachusetts has received a petition from the Providence & Fall River Street Railway Company for authority to increase its local fare unit from 5 cents to 6 cents, on the ground that the former rate is inadequate to prevent an annual deficit, despite the fact that the company has never paid dividends.

Maryland Commission

The Maryland Public Service Commission has resumed the hearing on the petition of the Mayor and City Council of Easton asking that the Easton Light & Fuel Company improve its plant and reduce rates. Testimony was presented in regard to the general condition of the plant and its ability to furnish gas and electricity. Mayor Higgins of Easton stated to the commission that a bill had been introduced in the Legislature giving Easton the right to erect a municipal electric plant.

Current News Notes

BINGHAMTON, N. Y., RESTRAINED FROM ISSUING BONDS FOR MUNICIPAL PLANT.—The Appellate Division handed down a decision at Albany, N. Y., on Jan. 21 in the case of W. S. Lyon, of Binghamton, against the Common Council of that city, restraining the issuance of a bond issue of $158,200 for a municipal lighting plant in Binghamton, N. Y.

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KALAMAZOO (MICH.) MUNICIPAL LIGHTING PLANT NEARING COMPLETION.—On Jan. 28 fires were lighted under the boilers in the 1000-kw municipal lighting plant which has just been erected at Kalamazoo, Mich. A celebration has been planned for Feb. 14, when the city's new "white way" will be lighted for the first time. Energy for this lighting will be supplied from the municipal lighting plant.

* * *

ACROSS THE ALPS IN AN ELECTRIC BUS.—Settling any question of the hill-climbing abilities of the electric vehicle, an electric-bus service has been established across the Alps from Airolo, Switzerland, to Ulrichen, Italy. The route traverses the Bedretto valley and Nufenen Pass. Each car carries twenty-two passengers and makes the trip in one and three-quarter hours, running at 12 to 22 miles per hour.

* * *

PRIZE WINNERS IN N. E. L. A. SECTION CONTEST.—In the H. H. Scott prize competition given under the auspices of the National Electric Light Association, in which contestants were asked to give the best ten reasons why employees of member companies should join a company section of the N. E. L. A., awards have been made as follows: First prize, $25, Mr. Roy G. Monroe, Denver Gas & Electric Light Company; second prize, $15, Mr. Herbert A. Seymour, Commonwealth Edison Company, Chicago; third prize, $10, Mr. Walter Christ, Philadelphia Electric Company.

* * *

A QUARTER OF A MILLION TONS OF COAL IN STORAGE.—A fuel agent and thirteen clerks are necessary to conduct the work of the fuel department of the Commonwealth Edison Company and some of the allied Insull companies, according to Mr. C. E. McBride, who recently read a brief paper on the subject at a company section meeting of the N. E. L. A. The Commonwealth Edison Company burns about 5000 tons of coal daily and its coal bill is about $2,000,000 a year. About 250,000 tons of coal is kept in reserve in or near Chicago at all times. Nearly all of this is of egg or lump size, as the danger of fire from spontaneous combustion is much less with the larger sizes. Thermometers are placed in all coal piles and weekly records of temperatures are taken. It is frequently found necessary to move piles of screenings or mine-run coal to prevent or fight fires.

* * *

AN ELECTROMAGNETIC EXPLANATION OF ANIMAL INTELLIGENCE.—A certain recent astounding instance of intelligence on the part of a trick elephant who could add, subtract and perform simple arithmetical problems now seems to be explained on the basis of electromagnetic aid given the animal by his astute trainer. One day, while watching a lifting magnet at work, the showman conceived the idea of using the subtle lines of magnetic force to direct the movement of his pachyderm's proboscis. Accordingly, a special blackboard was arranged, there being mounted behind it a number of electromagnetic pole pieces in the shape of numerals. The elephant was easily taught to rub a piece of chalk aimlessly back and forth over the board surface, but when the proper circuit was switched on corresponding to the sum desired the huge beast would unwittingly trace the answer in black and white, to the rapt amazement of his audience.

* * *

SUN-POWER PLANT AT CAIRO, EGYPT.—Tests on the sun-power plant at Meadi, near Cairo, Egypt, which has a sunshine-collecting surface of 13,000 sq. ft., heating five boilers, have shown an average of 1170 lb. of steam generated per hour, the pressure varying from 1.1 lb. and 1 lb. per sq. in. above atmosphere. A maximum output of 1442 lb. of steam per hour was obtained about noon Aug. 22, 1913. These experiments were conducted under favorable weather conditions, the average shade temperature being 95.5 deg. Fahr. and the mean humidity 35 per cent. The computed maximum steam production per square foot of sunshine-collecting area was 0.12 lb. per hour. A steam engine, especially designed to operate on pressures of 1 lb. per sq. in., consumes 22 lb. per brake-hp-hour when carrying a load of 97.5 hp. If use had been made of nine boilers instead of five, it is declared that the engine could have been operated for twelve and one-quarter hours per day with a load of 95 brake-hp.

* * *

FRILLS INCREASE THE RATE.—In a recent issue the *Kenosha News*, of Kenosha, Wis., said in discussing changes which have been brought about by commission regulation: "A rate for a public utility now is absolutely under State supervision, and any time that the utility gets the 'all that the traffic will stand' idea it is promptly taken out of it by the commission. Rates are now a matter of scientific arrangement of figures. If the people of a community demand underground wires, painted poles and a lot of other things that go to the beautifying of a city, they can have them, but they must pay for them. If the company is forced to increase its investment, the rule of the commission works automatically and it gets along with the increase of investment permission to increase the rate. Utility service is worth just so much. This price is set for utility service without any frills. If the frills are to be put on, the service is made more costly just the same as the dress of the woman is made more costly by the addition of a lace girdle."

IMPROVED EFFICIENCY OF TUNGSTEN LAMPS.—During the last few months the specific consumption of tungsten lamps has been considerably reduced, this increase in efficiency having been brought about by gradual refinement of the methods of construction and the materials which enter into the manufacture of the lamps. Perhaps the most noteworthy of these changes is that for the 110-volt lamps in sizes larger than 100 watts. The specific consumption of these units has been reduced to 0.90 watt per candle, directly increasing the candlepower over 11 per cent. The 20-watt, 110-volt lamp has been similarly improved from 1.25 watts to 1.17 watts per candle, while the new 40-watt lamp has a specific consumption of 1.10 watts per candle. "Half-watt" street series lamps, having an actual specific consumption of 0.7 watt per candle, are now regularly available in 80, 200, 350, 600 and 1000-watt sizes for both 6.6-amp and 7.5-amp circuits. For 110-volt multiple operation there are offered both a 750-watt lamp of the above efficiency and a 1000-watt lamp which operates at 0.65 watt per candle.

* * *

SOCIETY MEETINGS

CHICAGO JOVIAN LEAGUE.—At the luncheon of the Chicago Jovian League on Feb. 2 Mr. R. C. Leonard, of the Nashville Railway & Light Company, statesman for Tennessee, made a few remarks. The principal address of the meeting was delivered by Mr. Martin J. Wolf, Hotpoint Electric Heating Company, who talked on co-operation. Cuff links were distributed to twenty-three members for securing candidates for the recent rejuvenation. These cuff links bear the Jovian emblem and are of gold, gold plate or silver, depending on the number of candidates secured by the recipient.

* * *

CONVENTION PLANS OF NEW ENGLAND N. E. L. A. SECTION.—The executive committee of the New England Section of the National Electric Light Association has decided to hold the sixth annual convention of the section on Sept. 2-4 inclusive, at the New Mathewson Hotel, Narragansett Pier, R. I. A reception will be held on the opening day, followed by a technical program of much interest, and it is expected that the time and place will be favorable to a large gathering. Mr. C. C. Wells, of Middlebury, Vt., is president, and Miss O. A. Bursiel, 149 Tremont Street, Boston, Mass., is secretary of the New England Section.

* * *

PHILADELPHIA SECTION, N. E. L. A.—At a meeting of the Philadelphia Electric Company Section of the National Electric Light Association, Jan. 19, Prof. Robert H. Fernald delivered an address on "The Possible Central-Station Plant of the Near Future," advocating generation of electrical energy at the mouth of the mine. The commercial branch met Jan. 26, when Mr. Edwin Hulley read a paper on "Selling Electric Motor Service." At the accounting department meeting of Jan. 13 Mr. E. G. Walls spoke on the topic of depreciation. The meter and engineering department branches held a joint meeting Jan. 5, which was addressed by Mr. Louis G. Smith.

* * *

JOINT MEETING OF MUNICIPAL ART AND ILLUMINATING ENGINEERING SOCIETIES IN NEW YORK.—A joint meeting of the Municipal Art and Illuminating Engineering Societies will be held on Feb. 11 in the Engineering Societies Building, New York. Mr. Arthur Williams, vice-president of the Municipal Art Society, will represent that organization, the subject of his speech being "Some Notes on Present-Day Street Lighting." An address will also be made by Mr. C. F. Lacombe, chief engineer of the Department of Water Supply, Gas and Electricity, who will present the results of a recent trip to Europe to investigate the street lighting of cities there in a paper entitled "High-Intensity Lighting of European Cities, Compared with New York."

* * *

COMMONWEALTH EDISON COMPANY SECTION, N. E. L. A.—At the meeting of the Commonwealth Edison Company section of the National Electric Light Association in Chicago on Jan. 29 a number of short papers were read to explain the workings of different departments of the company's business. Mr. W. R. White told about the information bureau, Mr. E. W. Jones of the laboratories of the testing department, Mr. O. A. Witte of the outside work of the testing department, Mr. C. E. McBride of the fuel department, Mr. F. J. Kaeter of the contract department, Mr. Harold Wright of contract order routine, and Mr. R. B. Kennedy of load dispatching. The author of each paper was asked to make a summary of it in four minutes, and a minute and a half was given to each man taking part in the discussion, with two minutes for the author in closing. Among those who discussed the papers were Messrs. R. H. Hastings, auditing department; W. A. Schaefer, cashier's office; J. W. Ferguson, contract department; George H. Jones, contract department; C. A. Keller, engineering department; J. C. Manley, construction department; W. H. Childs, operating department; H. Foster, Northwest station; E. Mandel, testing department; W. J. Dwyer, credit department; A. F. Bronwell, distribution department; Otto Hanf, treasury department, and A. G. DeClerq, Northwest station. The Mandolin Club gave some pleasing music, the Glee Club sang, and Mr. W. J. Norton gave a humorous monologue.

* * *

CHAMBER OF COMMERCE TO DISCUSS ANTI-TRUST LEGISLATION.—The Chamber of Commerce of the United States will hold its second annual meeting in Washington, D. C., on Feb. 11 to 13. On the afternoon of Feb. 11 the report of the committee on patents, trade-marks and copyrights will be presented by Mr. James G. Cutler, Rochester, N. Y. On the evening of that day addresses will be made by Mr. William B. Wilson, Secretary of Labor, on "The Relation of the Department of Labor to Industries and Commerce," and by Mr. Charles A. Prouty, of the Interstate Commerce Commission, on "Physical Valuation of Railroads." Anti-trust legislation will be discussed on Feb. 12. Concentration of industry in the United States and respects in which the Sherman law requires definition will be taken up first. The abolition of holding companies and interlocking directorates will be considered. Another subject will be the rights and privileges of private parties in invoking the aid of the Sherman law. The functions of a federal interstate trade commission will be discussed. Another point is as to the industrial efficiency of the trust form of organization. Among the speakers will be Dr. Charles R. Van Hise, president University of Wisconsin; Mr. Louis D. Brandeis, Boston, Mass.; Mr. Frederick P. Fish, formerly president American Telephone & Telegraph Company; Mr. Victor Morawetz, New York; Prof. Henry R. Seager, Columbia University, and Mr. Henry R. Towne, president Yale & Towne Manufacturing Company. The subject of maintenance of retail prices will be discussed on Feb. 13. The opening address on this subject will be made by Mr. Joseph E. Davies, commissioner of corporations, Department of Commerce. At a banquet to be held on Feb. 12 an address will be made by Mr. William C. Redfield, Secretary of Commerce.

Alternating-Current Supply in New York City—I

New station of the United Electric Light & Power Company at 201st Street and Harlem River—History of alternating-current growth in New York

THE new 201st Street generating station of the United Electric Light & Power Company, New York City, representing a present investment of $5,000,000 and an additional amount of about $1,000,000 when fully equipped, is the latest word in central-station construction in that city. The station has just been placed in operation and embodies features of engineering interest. The United Electric Light & Power Company, it should be pointed out, distributes alternating current exclusively throughout the entire borough of Manhattan, whereas the New York Edison Company distributes direct current. The service of the United Electric Light & Power Company is entirely underground, and north of 135th Street on Manhattan Island the service of the company prevails exclusively. In round numbers more than 34,000 customers are supplied with energy by this company.

Growth of Alternating-Current Service in New York

The growth of alternating-current service in the borough of Manhattan is inseparably linked with the history of this company, which was expressly organized for the purpose of introducing the alternating-current system in New York City. Although the United Electric Light & Power Company was incorporated on Feb. 4, 1887, under the name of the Safety Electric Light & Power Company, which was changed to the present corporate title on Dec. 9, 1889, its history goes back as far as 1880, when the United States Illuminating Company, which was subsequently taken over by the United Electric Light & Power Company, was formed. The early business of the United States Illuminating Company consisted in selling outright or in installing and maintaining dynamo machines with arc lamps and appurtenances on a daily, weekly or monthly charge. At first these plants were installed where steam was available, the steam being purchased at so much per horsepower, the rates ranging from $75 to $130 per hp-year, delivered at the countershaft. The system at that time used was developed by Mr. Edward Weston, and the apparatus was manufactured by the Weston Electric Light Company. The latter was early acquired by the United States Electric Lighting Company, which was in turn later controlled by the Westinghouse company. The United States Illuminating Company acquired the exclusive control of the Weston system for the city of New York and for some of the adjacent counties including Kings, Queens, Richmond and Westchester, as

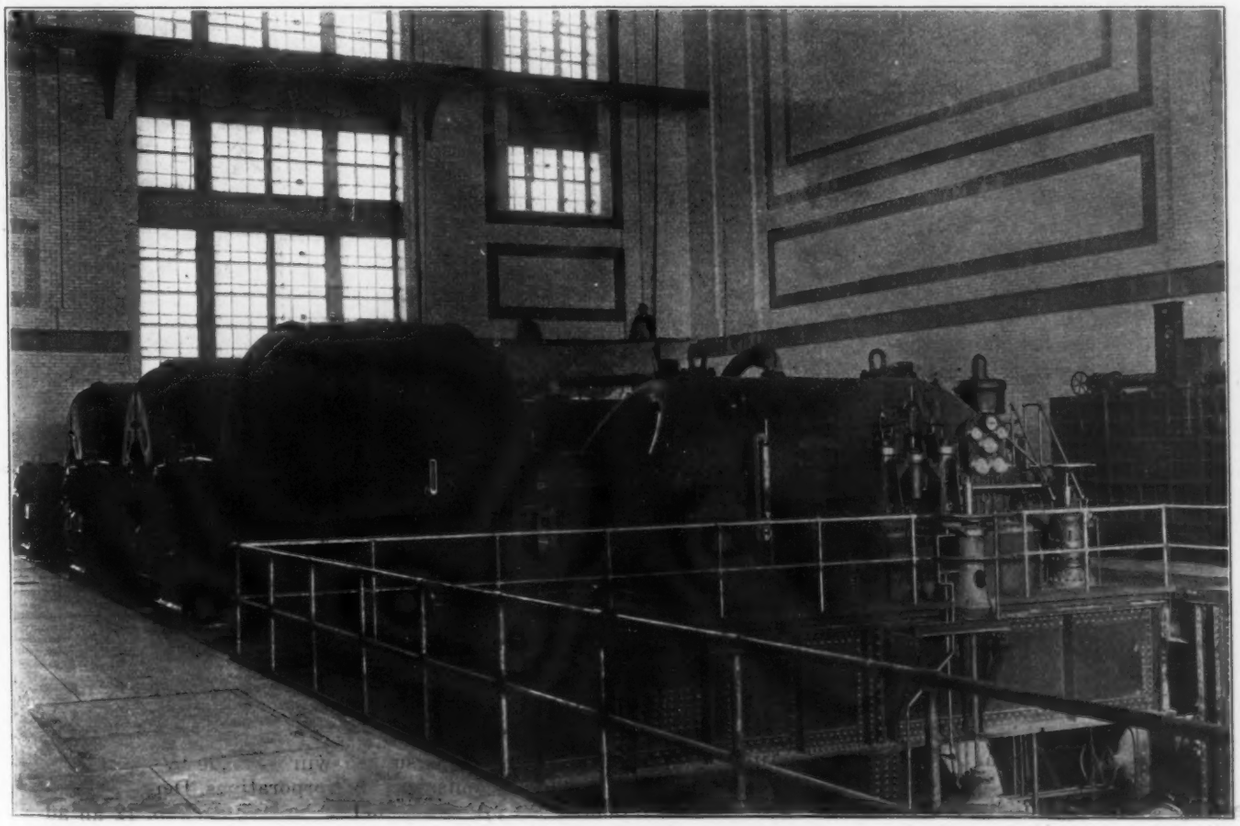
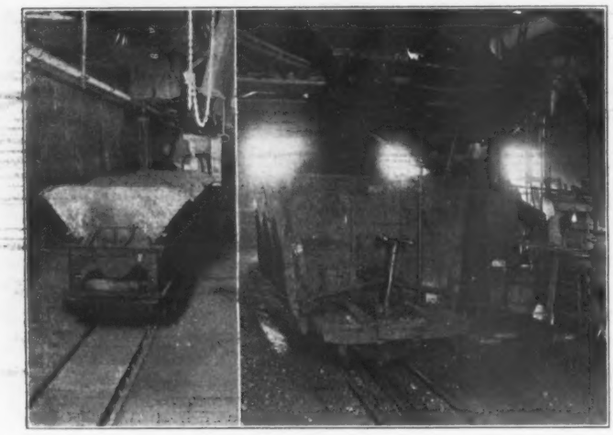


FIG. 1—19,000-KVA TURBO-GENERATORS

well as Hudson, Bergen and Union Counties in the State of New Jersey.

On May 1, 1881, the company rented the first floor and basement of the premises at 90 Chambers Street, where there was installed for experimental purposes a fifty-light Weston dynamo belted to a 20-hp horizontal steam engine. The first generators from which cus-



FIGS. 2 AND 3—ELECTRICALLY OPERATED ASH CARS AND ENDLESS-CABLE-OPERATED COAL CARS ON WEIGHING SCALES

tomers were supplied were in the basement of the old Equitable Building at 120 Broadway. The United States Electric Lighting Company had also about that time installed a machine in the basement of 215 Center Street and another in the basement of 414 Sixth Avenue, both of which were afterward taken over by the United States Illuminating Company. At that time the circuits were run entirely over the housetops.

By 1884 the company had eight stations in operation, feeding 590 arc lamps and about the same number of incandescent lamps from about 109 miles of circuit. For city arc service 75 cents a lamp a night, or $273 a lamp a year, was received, the rates for commercial arc service being as high as $1.25 a lamp a night. Energy for incandescent lamps was supplied at a flat rate of $3.50 a lamp a month. One of the important early installations was that of the Brooklyn Bridge (1883). The plant was installed by the United States Electric Company and operated by the United States Illuminating Company. The installation consisted of seventy Weston arc lamps, and the posts, frames and much of the original wire are still in service. During 1884-1885 two larger stations were erected, slow-speed reciprocating engines being used with ten, twenty and fifty-light machines belted from countershafting. At that time the gross annual income of the company from all sources, including rental from plants, had reached the sum of approximately $275,000.

Meanwhile the Edison system, the first station for which was placed in operation in New York in September, 1882, was making relatively great advances, and the Brush company had also established a plant on Elizabeth Street and was doing quite a large arc-lighting business. On May 31, 1887, franchises were granted to six additional electric light companies by the Board of Aldermen. In that year the alternating-current system was first brought to the attention of the Safety Electric Light & Power Company, and a proposition was submitted by the Westinghouse company whereby the Safety Electric Light & Power Company was to acquire the system under a license agreement. Two years later the plant and property of the United States Illuminating Company was leased by the Safety Electric Light & Power Company, and the first commercial alternating-current incandescent lighting service was begun in New York City. During 1891-1892 the United Electric Light & Power Company had acquired the property of the Brush Electric Illuminating Company. The inclosed arc lamp was being developed during the same period, and the Brush and Weston series systems were rapidly becoming obsolete, and finally disappeared.

The alternating-current system was pushed with great energy and skill by the Westinghouse and Thomson-Houston companies, but for several years progress was hindered by the difficulties encountered. In the first place alternating-current motors had not been developed to a point where they would bear comparison with the then-existing direct-current motors; neither was alternating-current arc lighting developed for commercial uses, so that these and many other drawbacks hampered the rapid growth of the business. Up to 1895 the United Electric Light & Power Company had 135 miles of subway duct under rental, but its service did not extend north of Fifty-ninth Street. The original primary service was 1000 volts, single-phase, 133 cycles. A station at Twenty-eighth and Twenty-ninth Streets and East River was bought by the United States Illuminating Company and was enlarged from time to time. On March 17, 1896, the first commercial operation of directly connected alternating-current generators was successfully inaugurated at that plant, which finally became the sole generating station of the company and was kept in operation until Nov. 18, 1907. On the later date the plant was shut down, the site and equipment being sold to the city of New York for hospital purposes.

It became imperative that immediate arrangements be effected for the generation of sixty-cycle energy,

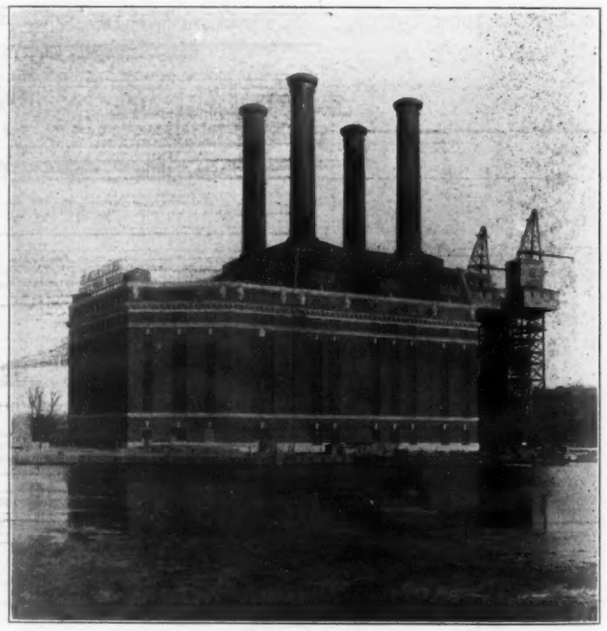


FIG. 4—EXTERIOR OF STATION, SHOWING COAL-HOISTING APPARATUS

and as a temporary expedient generating equipment was installed at the Waterside station of the New York Edison Company, and substations were equipped with transformers for sixty-cycle service and with motor-generator apparatus, so as to make it possible to use twenty-five-cycle energy from Waterside station as an emergency or reserve supply. Up to the opening of the

new station sixty-cycle energy has been generated in the Waterside stations of the New York Edison Company at 6600 volts and 7500 volts, sixty-cycle, three-phase, and delivered to substations, where it is transformed to 3000-volt, two-phase energy for primary distribution. With the starting up of the United Electric Light & Power Company's 201st Street station, however, the generation of sixty-cycle energy for New York City and the surrounding territory was transferred to the new station, which will be assisted only at peaks by the Waterside stations. The two systems are connected by four tie lines, which follow different routes so as to preclude the possibility of all four failing at once owing to any mishap.

The United company's plant is laid out to accommodate all the boiler and generating equipment which it is expected will be needed in the next ten years. In 1913 the United company produced and purchased 62,656,409 kw-hr. of energy, and that distributed to its consumers exceeded by 34.7 per cent the energy distributed during the previous year. During 1913 there was a general increase in the sixty-cycle load in all sections of the United company's territory. It is interesting to note that in 1909 the ratio of energy demand to the total was 45.86 per cent south of Fifty-ninth Street, 21.49 per cent from Fifty-ninth Street to 135th Street and 32.65 per cent north of 135th Street, while in 1913 the ratios in these districts were respectively 32.66 per cent, 20.22 per cent and 47.12 per cent, showing that the majority of the energy demand has shifted northward. The section north of 135th Street on Manhattan Island is supplied exclusively from the mains of the United company, and all that important electrical

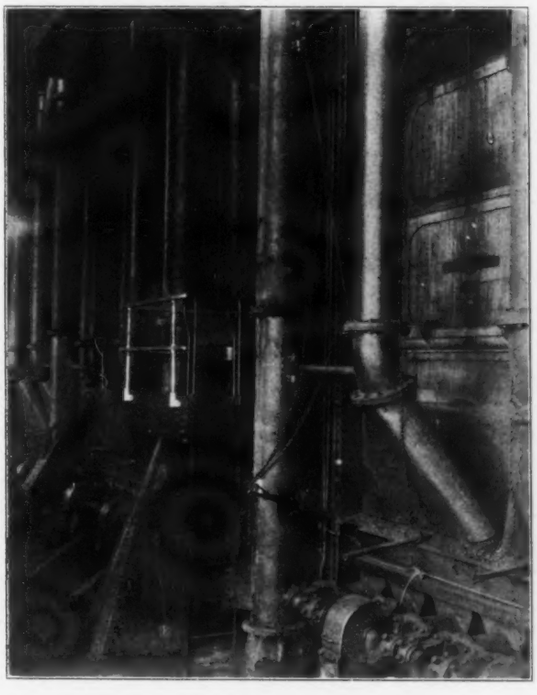


FIG. 5—COAL DOWNTAKES AND CONSTANT-SPEED MOTOR DRIVING STOKERS

development in the northern section has been along the lines of sixty-cycle supply.

Features of Generating Station

One of the main features in the 201st Street station is the almost universal use of turbine-driven auxiliaries, no reciprocating engines being employed except for hoisting coal and circulating lubricating oil. Relatively high-speed main generating units are installed, each being equipped with a blower driven by two motors, one acting as an emergency reserve. Duplicate high-tension buses divided into four sections are employed which can be connected in two loops through bus-tie switches and reactors. The 7500-volt induction motor-driven exciters also charge the storage battery

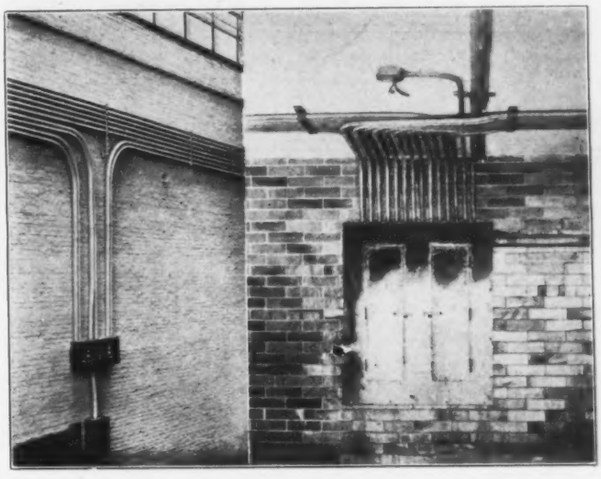


FIG. 6—TYPICAL CONDUIT WORK ON WALLS AND CEILINGS

and will deliver 250 volts to 350 volts direct current, thus making it unnecessary to operate a booster generator. The storage battery end-cell switch is operated automatically by a specially designed remote-control switch which shows when the end-cell switch is operating and indicates the number of cells in series. Elaborate coal and ash handling apparatus is installed and the mammoth coal bunkers located just below the roof are designed to prevent spontaneous combustion. Space is provided for a double deck of seventy-two boilers, only thirty-two of which are at present installed. These are equipped with the most modern automatic apparatus and with special-drive stokers.

Each bank of high-tension transformers feeding the tie lines and substations is cooled by individual motor-driven blowers which start automatically when the transformer bank is energized. A special three-phase balanced alternating-current lighting scheme is employed in the station which permits of connecting small polyphase motors to the lighting distribution panels when necessary. A new system of heating the high-tension galleries is employed which eliminates the danger caused by steam or water escaping near the bus compartments. An ingeniously constructed load-indicating device for the boiler rooms is used which records on a tape the load, the time when a signal is transmitted from the high-tension switch room to the boiler room, and the time it is acknowledged. Among other features is the use of a 30,000-volt testing outfit with outlets at different points in the station. Provision is made for testing all auxiliaries and main turbines without setting up temporary apparatus.

Location and General Description

The station, which is of fireproof construction with an exterior of red brick, artificial granite and terra cotta, occupies about 62,220 sq. ft. of space at 201st Street, where the Harlem River joins Sherman Creek. It is divided into three sections and is about seven stories high. The high-tension bus and switching galleries are at the west end of the building, the turbo-generators and auxiliaries in the adjoining section, and the boilers, coal and ash handling apparatus at the

east end of the station. The building rests on 6600 piles driven to rock bottom.

The walls of the engine room, corridors and office space are faced with white-enameled tile, and the floors are of granolithic concrete set in cast-iron panels. In the boiler room the walls are made of salt-glazed brick

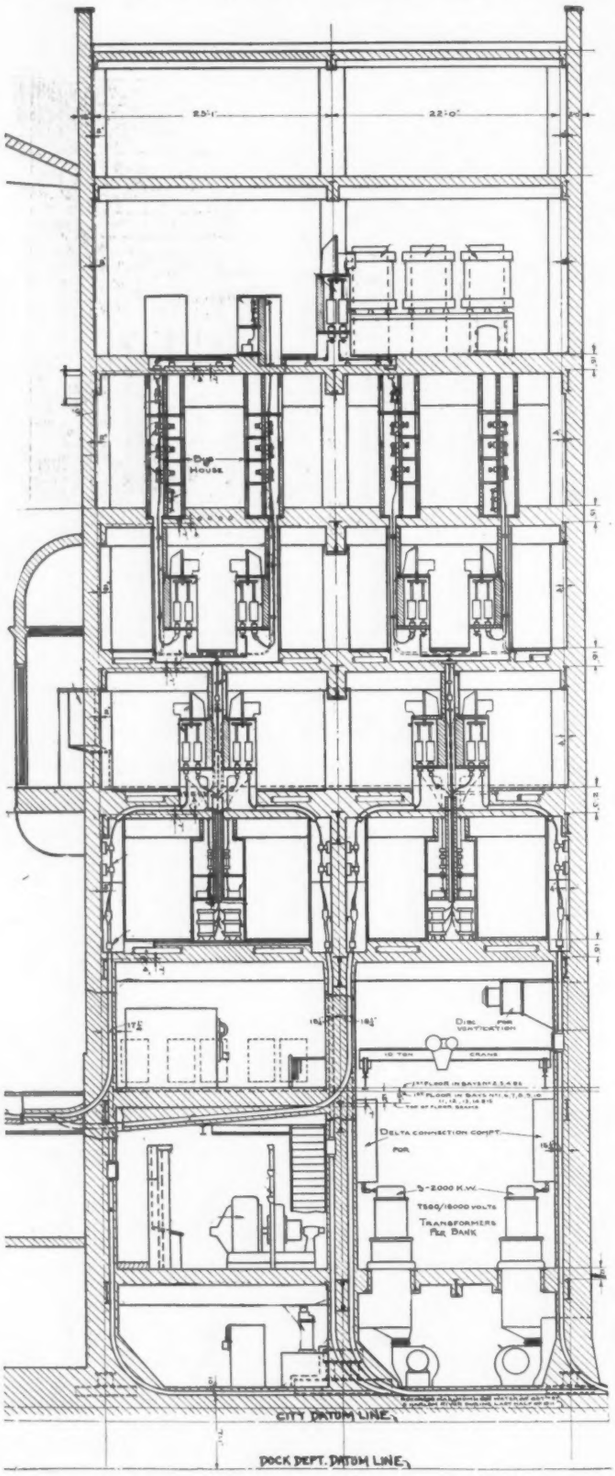


FIG. 7—HIGH-TENSION BUS AND SWITCH GALLERIES

to prevent dust collecting on them and to facilitate cleaning. From the ground floor to the roof of the boiler room there is no obstruction to ventilation, as grating has been employed for flooring on the several landings. This construction will prevent dirt accumulating and at the same time provide a light, airy and cool boiler room. Every part of the building is well lighted either through skylights or wall windows. The engine room is especially bright, having a mammoth window at each end and a large wire-glass skylight in the monitor. All window sashes are operated by a compressed-air system. Artificial illumination in the engine room is provided by thirty 500-watt tungsten lamps supported from ornamental wall brackets 45 ft. above the floor. Electric illumination in the other parts of the building is afforded by smaller units supported either from the walls or ceiling by rigid pendent fixtures. All doors and windows are constructed of metal. One passenger elevator installed in the west end of the building serves the galleries and office, while three others carry freight.

Coal-Handling Apparatus and Bunkers

Coal is delivered by boat to the Harlem River side of the building and is hoisted 184 ft. by 1.5 ton grab buckets to the top of a steel coal tower, where it is dumped into hoppers and passed through crushers. From the crusher the coal is conveyed in 3-ton cars, operated by an endless-cable system, to the 15,000-ton concrete coal bunkers located just below the roof of the boiler room. The coal hoists (one in each tower) are operated by one-man-control reciprocating engines. Three hundred tons of coal can be unloaded per hour when hoisting the buckets at 1200 ft. per minute. The

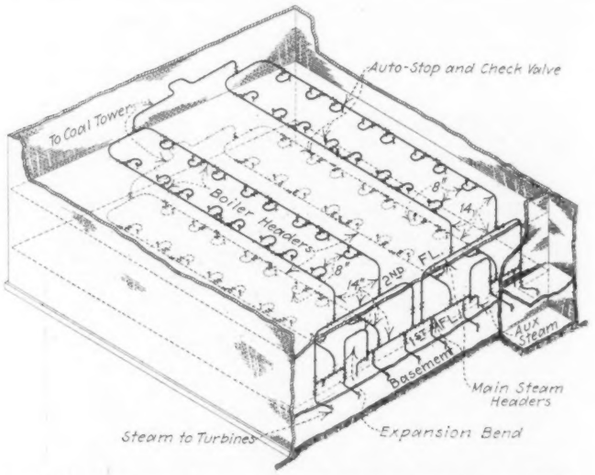


FIG. 8—LAYOUT OF BOILER AND MAIN STEAM HEADERS

crusher and endless cable operating the coal cars are driven by induction motors controlled by the men who fill the cars and weigh them. As constructed at present it is necessary to cease coal hoisting if the cable cars are tied up as the hoppers over the crushers are merely temporary receptacles and cannot hold much. Larger receiving hoppers will be installed later with steam valves between them and the crushers so it will be possible to operate the hoists continuously regardless of temporary interruptions to coal-car operation.

The 15,000-ton bunkers occupy the entire width and length of the upper part of the boiler room, and their walls have been constructed with sufficient slope to prevent coal accumulating in pockets and causing spontaneous combustion. The bunkers are V-shaped and are made of granolithic concrete supported by steel girders and trusses.

Boilers and Stokers

While space has been provided for a double-deck arrangement of seventy-two boilers, only thirty-two 650-hp Babcock & Wilcox boilers have been installed. This is all that will be required even with eight 19,000-

kva turbo-generators operating, as the United company contemplates forcing the boilers when the eight generators are installed. When the energy demand exceeds the output of eight 19,000-kva generators, higher-rated generators will be installed and the second deck of boilers erected. The boilers now in place are arranged in four rows of eight each with General Electric indicating and recording steam-flow meters in each header connecting a row of boilers with the main header. Besides the usual brick setting each boiler is provided with an additional heat insulation of asbestos board and magnesia and a sheet-steel casing. The boilers are set especially high (10 ft. above the floor) to provide sufficient combustion space when the boilers are overloaded. A steam pressure of 200 lb. will be maintained ordinarily and the temperature of the steam raised 125 deg. Fahr. by superheaters each having 750 sq. ft. of heating surface. Each drum on every boiler is equipped with a safety valve as well as an individual feed-water connection. The height of the water in the drums is maintained at a constant level by S. C. automatic regulators connected to the middle drum of each boiler. The boilers are also equipped with steam soot blowers for cleaning the tubes.

The stokers are operated in groups of four by constant-speed induction motors and the rate at which coal is fed to the grates is regulated by Reeves variable-speed cone transmissions. The stokers are connected by inclosed-chain drive to their respective group-drive shafts beneath the floor. Each shaft in turn is driven through an inclosed silent chain by a 30-hp Westinghouse motor, thus requiring eight motors for the present boiler installation. Each of these motors has sufficient power to drive all stokers in one row. In emergency this can be done by closing a clutch which connects the end of the adjoining shafts. While each stoker is capable of feeding about 6000 lb. of coal per hour, only 2500 lb. of coal is normally fired per hour, the boilers operating with a gas speed of 10.6 ft. per second in the flues. On a boiler in each section is installed an electric tachometer indicating the speed of the stoker-driving mechanism. On this instrument is a movable scale of air pressures below the fire giving the proper relation between this pressure and the stoker speed. Apparatus is also installed so that an analysis can be made of the flue gas from each boiler.

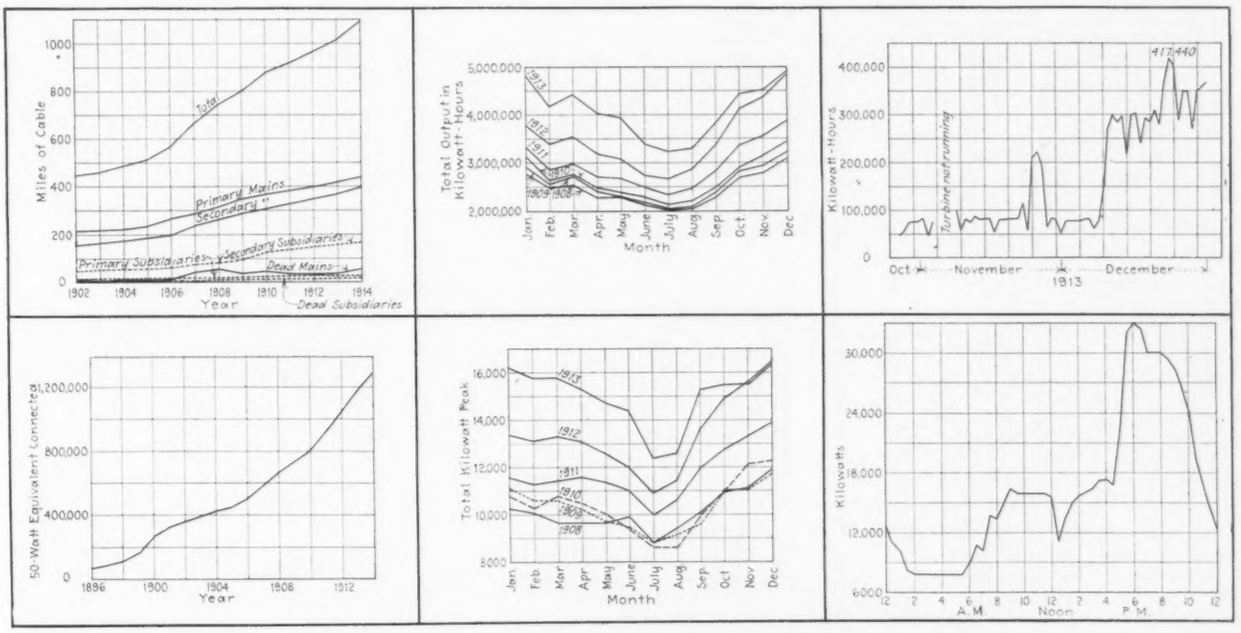


FIG. 9—DATA CURVES RELATING TO UNITED COMPANY'S BUSINESS

Taylor underfeed stokers are employed, the coal being delivered to their hoppers through elliptical-shaped downtakes communicating with the 15,000-ton bunkers located above. The downtakes, which are self-supporting, consist of vertical pipes (three to each pair of boilers) extending from the bunkers to the ground floor, where they rest on cast-iron pedestals in the firing aisle. Coal valves are placed in the lower ends of alternate vertical downtakes to allow coal to be delivered into the firing aisle for emergency hand firing. The same downtakes are arranged to feed boilers which may be installed later on the second deck. Normally the coal is delivered to the stoker hoppers through pipes branching off from the vertical downtakes and fastened to the front boiler header. Piston-type coal valves operated by chains are placed in these branch pipes above each hopper. To permit opening boiler headers for tube inspection, repair, etc., the branch pipes have been hinged on the vertical downtakes so that they may be swung from the headers.

The draft over the fires is maintained partly by 300-ft. stacks, of which there are four (one to each set of boilers), and partly by air pressure beneath the grates. The latter is furnished by Sturtevant blowers in the basement. The stacks are constructed of steel lined with hard red brick, the intervening space being filled with cement. Sufficient pressure is maintained beneath the grates just to overbalance that above, thus preventing any leakage of cold air through the boiler settings or smoke ducts.

There are four sets of forced-draft blowers, each consisting of three Sturtevant fans connected through helicoidal gearing to steam turbines. One fan of each set is held as a reserve, the other two being capable of delivering 80,000 cu. ft. against a static head of 5 in. of water. Each blower set delivers air to a duct supplying eight boilers.

In a later issue of the *Electrical World* will appear a description of the remaining mechanical equipment, including the cinder catchers, ash-handling apparatus, steam-header piping, etc., followed by a detailed account of the features of the electrical equipment.

Booster-Control Test on Metropolitan Railway, Paris

Obtaining acceleration and retardation in electric traction by varying voltage at armature terminals and currents in field circuits with motor-generator sets. By Charles Jacquin

ONE of the most important problems of electric traction is that of efficiency in acceleration and retardation. If we ignore commercial claims, it must be admitted that very little progress has been made in this field, especially with direct-current equipment. The standard method of combining series-parallel operation with the use of resistances has two important drawbacks—it wastes energy in starting and stopping, and, in multiple-unit equipment, it leads to great complication.

In single-phase equipment the speed can be regulated by the use of an auto-transformer or an ordinary transformer to vary the voltage applied to the motors. This method looks very simple on paper, but those who have had experience know that it is not so attractive in practice. The absence of resistance losses is certainly of great advantage on suburban lines, but it is of little importance on trunk lines with few stops. The difficulty lies in passing from one voltage step to another.

In 1894, just twenty years ago, the Ward-Leonard system was tried on the Heilmann locomotive, which carried a gas engine coupled to an electric generator. On this locomotive the speed regulation of the traction motors was obtained by varying with a small special exciter the independent shunt excitation of the main generator. This method had the disadvantage of weight, but the saving of energy in starting and stopping was incontestably good and the control was very simple. These tests, which were made on the former Western (now State) Railways, were considered a great success.

About 1895 the Western Railway made further tests with the straight Ward-Leonard system, comprising a booster in series with the traction motors instead of a gas-electric set. In this outfit the booster produced an emf which permitted the motor voltage to vary from zero to double the line potential. The tests were discontinued because the starting was not automatic, regeneration was practically impossible and, lastly, the system did not allow multiple-unit operation.

It was not until 1913 that any further work of importance was done in this field. Then an important step was taken by the Jeumont company (Ateliers du Nord et de l'Est de la France à Jeumont) in the construction of a new control equipment for the Metropolitan Railway of Paris.

An interesting point about the new control is that it is merely a small modification of a device which has been applied to European mining machinery for the last four or five years. In short, it is the application to electric traction of the Ward-Leonard principle in which the voltage at the traction motor armature terminals is varied by means of a motor-generator set, the currents in the field circuits of the traction motors being independently varied by means of another motor-generator set both mechanically and electrically associated with that just mentioned. The railway apparatus has been developed chiefly by M. Legouez, chairman of the Société pour l'Industrie des Chemins de fer. The surprising results hereinafter quoted were obtained from a test of several months' duration on a Metropolitan train.

Apparatus and Connections of Booster Control System

The wiring scheme of the Jeumont company's control system is shown in one of the accompanying diagrams. The letters M_1 M_2 and m_1 m_2 represent the rotors and fields of the ordinary direct-current traction motor, the two armatures being permanently operated in series and the two fields being permanently connected in series. The machines F_1, F_2 and F_3 represent the motor-generator set, the functions of which will now be explained. F_1 and F_2 represent a booster group and F_3 a small regeneration dynamo. The booster group itself comprises two commutating machines F_1 and F_2, the rotors of which are mounted mechanically on the same shaft, one working as a motor and the other as a generator. The functions of these machines are reversible, depending upon operating conditions, but F_1 is always connected in series with the traction motors by a two-way switch

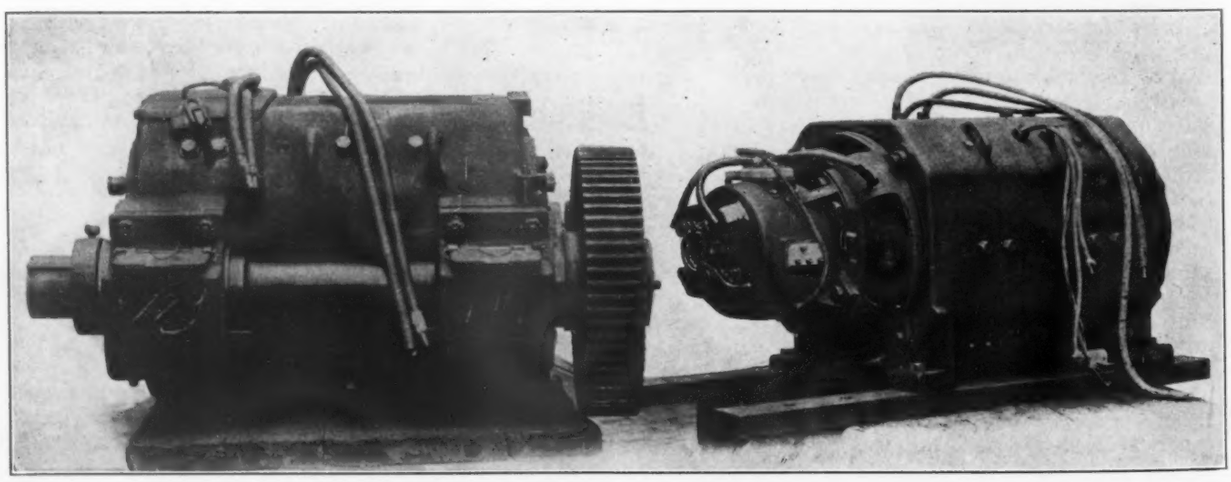


FIG. 1—175-HP TRACTION MOTOR

"3." By means of switch "4" the armature of F_2, the regeneration dynamo, is joined in parallel with the field coils of the traction motors. This machine serves for varying the excitation of the traction motors. The machine F_3, which operates at a constant speed, is simply a combined dynamo connected across the line, its shunt-exciting circuit being shown as D_1 and its series circuit as D_2. The regulating generator F_1 has two exciting circuits, one being the circuit H which receives a constant current from the line X and the other the circuit E connected in shunt with its own armature and that of machine F_3. The regeneration dynamo F_2 also has two exciting circuits, one, A, connected directly across the line X to produce a constant excitation, the other, B, connected in parallel with the armature circuit of the regulating dynamo F_1 to give an excitation varying in direction and intensity with the emf of this machine; that is to say, the excitation of F_2 depends upon the speed of the traction motors.

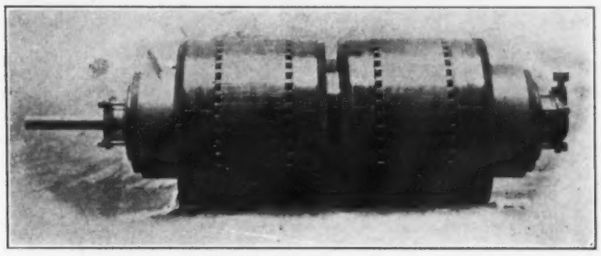


FIG. 2—ARMATURE OF BOOSTER REGULATOR

In starting from rest, the line switch is closed, the reversing switch 2 of the regeneration dynamo being in the proper position. Then the booster group is brought to normal speed with the small rheostat *rh*, machine F_3 now acting as a motor. Until this moment switch 3 has been kept open to avoid excessive current in the main motor circuit. As soon as the booster group has attained its normal speed switch 3 is closed according to the direction of propulsion. The real starting operations follow next.

At first the emf of machine F_1 is in a direction to subtract from the main line voltage and thereby to decrease the voltage impressed on the traction motors. Under these conditions F_1 operates as a motor and drives F_2 as a generator, which therefore returns energy to the line X. Subsequently, as the main traction motors accelerate, the voltage across F_1 is reduced and finally reaches zero, under which condition the two traction motors operate as if in ordinary series connection, receiving the full line voltage. When the higher speed of travel is reached the dynamo F_2 runs as a motor and drives F_1 as a generator to produce an emf which adds to that of the line until the voltage impressed upon each traction motor is equivalent to that obtained during ordinary parallel connection. In this fashion, as the accompanying curves show, acceleration is obtained without waste of energy or discomfort to passengers. The reverse of the foregoing movements occur during retardation, the switch 2 being reversed, thereby altering the excitation of machine F_1, varying the emf impressed upon the traction motors and causing energy to be returned to the line.

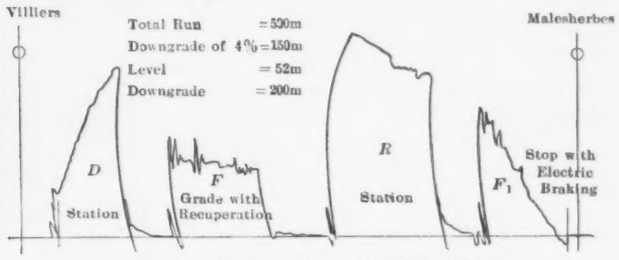


FIG. 4—ENERGY-CONSUMPTION CURVE

Estimate Energy Savings

The tests show an energy saving of 20 per cent. For instance, on one run the energy consumption of an ordinary multiple-unit equipment was 60 kw-hr. and of the new Jeumont equipment only 48 kw-hr. In braking it was found possible to regenerate 30 per cent of the energy used in starting. If the Jeumont system was applied to all trains of the Metropolitan Railway, the annual saving would be 20,000,000 kw-hr., or $200,000, at the very low rate of 1 cent per kw-hr. Other accessory but not insignificant advantages of this saving in energy would be less heating of the air in the subway and in the cars, less brake wear and metallic dust.

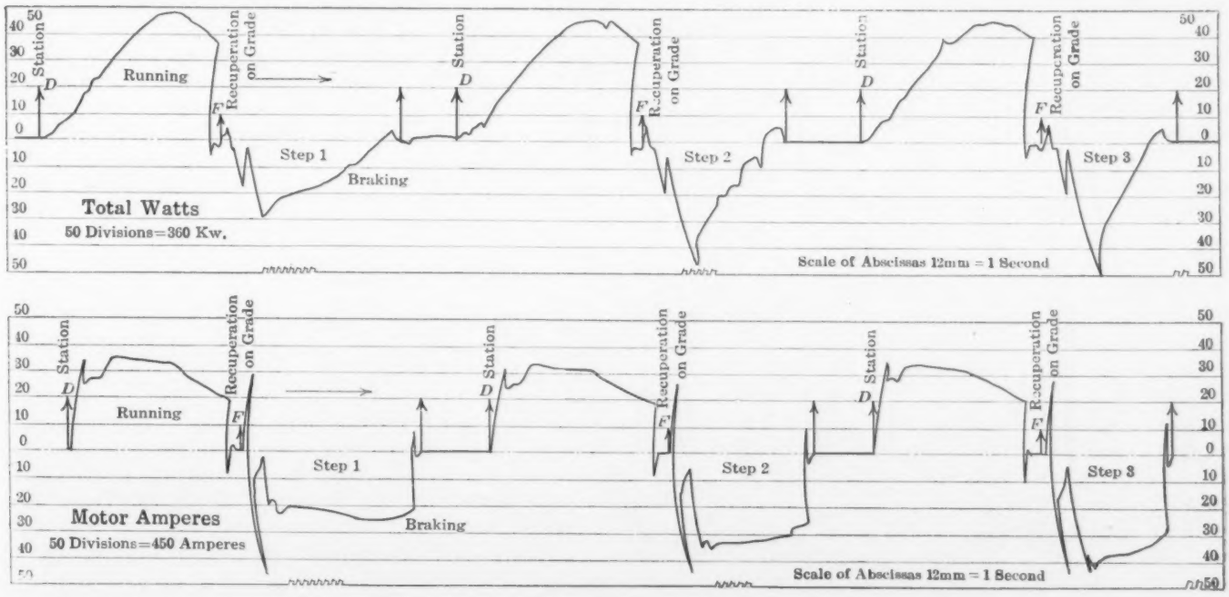


FIG. 3—ENERGY AND CURRENT CURVES OF BOOSTER-CONTROL SYSTEM

During the running period this control acts as a regulator to maintain a constant current automatically despite variation of speed due to grades, curves, etc. This system can readily be applied to multiple-unit trains with great simplification of apparatus. For instance, it would permit on a Metropolitan motor car with ordinary multiple-unit control the elimination of two contactors, of one reverser and of the starting resistances, a total of 990 lb. As the new devices weigh 4070 lb. per motor car, the actual increase in weight due to using a more efficient control would be 3080 lb.

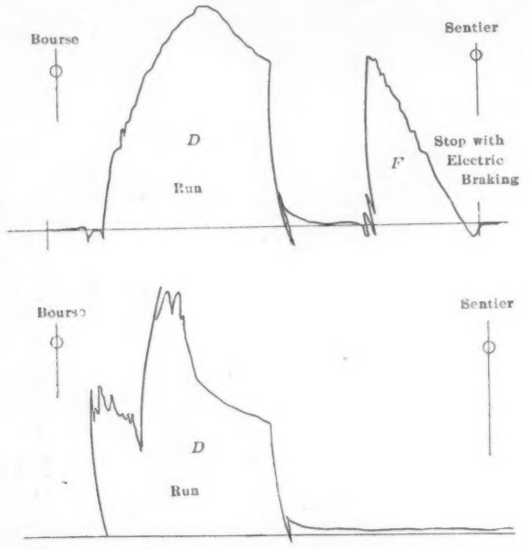


FIG. 5—COMPARISON OF ENERGY CONSUMPTION

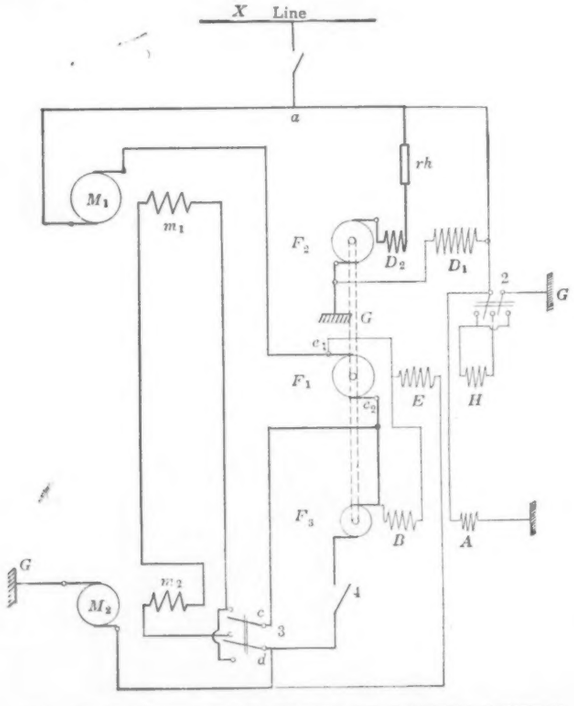


FIG. 6—CIRCUIT CONNECTIONS OF BOOSTER-CONTROL SYSTEM

The new system can be readily adapted for several maximum running speeds to permit most economical operation over sections with varying conditions. Three such maximum speeds were in service on the test train mentioned.

Preventing Buzzard Short-Circuits

In constructing its new aluminum-conductor transmission line into Baltimore from Holtwood, the Pennsylvania Water & Power Company has adopted a special spacing of 9 ft. between conductors to prevent "buzzard short-circuits." On the present lines very large birds, under proper weather conditions, may cause interruptions, but the new spacing of 9 ft. is expected to obviate this trouble.

Standardization of Battery Dimensions an Impediment to Development

Below is given an abstract of a paper read by Mr. E. J. Mudge, of the United States Lighting & Heating Company, New York, before the recent annual convention of the Society of Automobile Engineers, New York, criticising the battery specifications adopted by the society at that meeting.

Specifications requiring that batteries shall not exceed 7.5 in. in width and 9.5 in. in height, said Mr. Mudge, will discourage the future development of batteries for starting devices, since these dimensions will prevent variations in plate sizes and cell assemblies. The size specified practically compels the use of a plate having a width much greater than its height—a proportion not desirable, especially when various parallel combinations are required and the length of eight-cell to twelve-cell batteries has to be minimized. Should any shorter plates than those now employed be used to conform with the prescribed 9.5-in height, the battery itself would have to be increased about 6 in. in length, making it longer than most cars can accommodate.

Limiting the height of a storage battery to 9.5 in. will also discourage any special efforts to design batteries having the proper expansion space above the plates and provisions for maintaining the proper acid height. Although the extension of battery handles above the terminals and connections may minimize short-circuits, there is no particular reason why such practice should be standardized, as the metallic battery cover will serve the same purpose if properly designed.

Mr. Mudge believes that the final voltage on a discharge test conducted at the 5-amp rate should be 1.7 volts per cell instead of 1.8 volts to give a fair average for all sizes of batteries. To conform with the present general practice it was suggested that 70 deg. Fahr., instead of 80 deg., be used as the standard temperature at which to rate batteries. Specifications should also include the height of the acid above the tops of the battery plates and the specific gravity of the acid at full charge when the electrolyte has evaporated to a level just covering the tops of the plates. The last specifications especially should be required during factory tests to prevent manufacturers deliberately overrating batteries by using too concentrated electrolyte or too large a volume of acid. If the surface of the electrolyte is above the normal level, the acid will, when evaporated, become so concentrated as to destroy the wooden separators.

The method prescribed in the S. A. E. specifications for determining the ability of a storage battery to respond to high rates of discharge for short periods, when operating an electric cranking motor on automobiles, is considered very satisfactory by the author, as it will test the conductivity of the cell connectors and the mechanical construction of the battery. The method of rating is based on the maximum amperes which can be discharged for twenty minutes with a final emf of 1.65 volts per cell.

Parallel Operation of Transformers—I

Calculation of current in transformers connected in parallel, the total current being resolved into its components by vector and symbolic analysis. By Waldo V. Lyon

IN discussing parallel operation of electrical apparatus some writers lay considerable stress upon the so-called interchange or local currents which exist in the circuits between the apparatus but which are not present in the external circuit. Except in some special cases this method may lead to erroneous conclusions. It is, moreover, a reduction of a more general analysis in which the current in any one circuit is divided into several components each of which has a definite significance. If there are, say, three factors which affect the parallel operation of electrical apparatus, the current in any one branch may be divided into four components. The first is the ideal current which would exist if each of the factors had no effect. The second component is due wholly to the action of the first of these three disturbing factors, and similarly for the other two components. Thus, if any one of the disturbing factors is not present the component of the current which it in general produces is zero.

It is the present purpose to apply this method of analysis to the case of transformers operating in parallel. Owing to the close agreement of the simple theory with actual practice, the analysis is more exact with transformers than with any other apparatus. In dealing with transformers under load conditions, it is customary to neglect the exciting current and to assume that the core loss is constant. It can be shown that the errors introduced thereby are very small and, as far as the losses go, tend to offset one another.

The vector diagram which will be used to represent the conditions existing in a single transformer is given in Fig. 1.

The primary voltage V_1 is equal to the secondary voltage V_2 multiplied by the ratio of transformation a plus the equivalent impedance drop referred to the primary side. It is unimportant how the equivalent impedance is actually divided between the two sides of the transformer. This is only true, however, when the exciting current and the effect of a change in the mutual flux on the core loss are negligible.

If the equations that follow were written in full the voltage, current, impedance and admittance would be expressed in the symbolic notation of complex quantities.

The general condition for parallel operation is that the primary voltages and the secondary voltages shall be the same for all of the transformers. When the ratios of transformation are equal the solution is simple.

$$aV_2 + I_1z_1 = V_1$$
$$aV_2 + I_2z_2 = V_1$$

I_1, I_2, etc., are the primary currents and z_1, z_2, etc., are the equivalent impedances, referred to the primary sides of the transformers. These equations may be written:

$$I_1 = y_1 (V_1 - aV_2)$$
$$I_2 = y_2 (V_1 - aV_2)$$

The total current, I_o, is equal to the vector sum of the individual currents and is:

$$I_o = I_1 + I_2 + = (y_1 + y_2 +) (V_1 - aV_2)$$

Since in general the total current would be given, this equation should be solved for the common impedance drop.

$$(V_1 - aV_2) = \frac{I_o}{Y_o}$$

Y_o is the sum of the admittances expressed in the notation of complex quantities. The current in the first transformer is given by:

$$I_1 = \frac{y_1}{Y_o} I_o \qquad (1)$$

If the ratios of transformation are not the same for the several transformers, the solution is nearly as simple. In this case the equations are written:

$$a_1V_2 + I_1z_1 = V_1$$
$$a_2V_2 + I_2z_2 = V_1$$

The ratios of transformation are a_1, a_2, etc., the currents in the several transformers are I_1, I_2, etc., and the equivalent impedances, referred to the primary sides, are z_1, z_2, etc., respectively. The primary and secondary

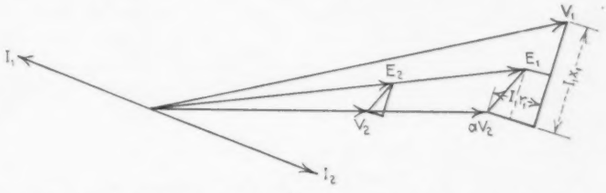


FIG. 1—VECTOR DIAGRAM OF CURRENTS AND VOLTAGES

potential differences are V_1 and V_2 respectively. Solving the first of these equations for I_1:

$$I_1 = \frac{1}{z_1} (V_1 - a_1V_2)$$

This is more conveniently written as:

$$I_1 = y_1V_1 - a_1y_1V_2 \qquad (2)$$

The total current on the primary side is the sum of the currents I_1, I_2, etc., and is:

$$I_o = I_1 + I_2 + \text{etc.}$$
$$I_o = (y_1 + y_2 +) V_1 - (a_1y_1 + a_2y_2 +) V_2$$

If Y_o is substituted for $(y_1 + y_2 +)$ and Σay for $(a_1y_1 + a_2y_2 +)$ this equation may be solved for V_2 and written in the following simple form:

$$V_2 = \frac{Y_oV_1 - I_o}{\Sigma ay}$$

If this value of V_2 is substituted in equation (2) the solution for I_1 becomes:

$$I_1 = y_1V_1 - a_1y_1\left(\frac{Y_oV_1 - I_o}{\Sigma ay}\right)$$

In this equation all of the quantities are known and thus the current in any transformer can be exactly determined. For the purpose of numerical solution it is better to change this into the form:

$$I_1 = a_1y_1 \frac{I_o}{\Sigma ay} + y_1\left(V_1 - a_1 \frac{V_1Y_o}{\Sigma ay}\right) \qquad (3)$$

The independent variables in equation (3) are y_1 and a_1. If the ratios of transformation are all equal this equation reduces to the form shown in (1).

This, then, is the general solution for the current in one of a number of transformers that are connected in parallel.

When the ratios of transformation are equal the current in each transformer is zero at no load. (See equation 1.) When the ratios are not equal, however, there is always current in at least two of the transformers at no load, but if three or more are connected in parallel some of them may not carry current at this time. Even under load conditions it is possible, though not probable, that there will be no current in one transformer when two are operating in parallel alone.*

In order to apply the principle of analysis which has been outlined, it is first necessary to determine the factors which influence the parallel operation of transformers. These are three: First, the ratio of transformation; second, the ratio of equivalent resistance to equivalent reactance, and, third, the equivalent impedance volts at the maximum allowable current. Under the assumptions of negligible exciting current and of core losses which depend only upon the impressed primary voltage these are the only factors which affect parallel operation. Thus the total current to any one transformer should be divided into four components. The first is the ideal current which would exist if the transformers were perfectly suited for parallel operation. The second is the component which is caused by unequal ratios of transformation. The third is the component caused by the inequality of the ratios of equivalent reactance to equivalent reactance in the several transformers, and the fourth is the component caused by the inequality of the equivalent impedance volts at maximum allowable current. The actual current in the first transformer in the general case is given in equation (3). If the ratios of transformation are the same, the current is as given in equation (1) The difference of these two currents gives then the component of the current which is due wholly to the inequality in the ratios of transformation. This component will be designated as B.

$$B = y_1 \left\{ V_1 - a_1 \left(\frac{Y_0 V_1 - I_0}{\Sigma a y} \right) \right\} - y_1 \frac{I_0}{Y_0}$$

This equation for B may be rewritten in a better form:

$$B = y_1 \left(V_1 - \frac{I_0}{Y_0} \right) \left(1 - a_1 \frac{Y_0}{\Sigma a y} \right)$$

The independent variables are y_1 and a_1.

The second factor of the component B is the primary voltage less what may be called the average equivalent impedance drop in the transformers referred to the primary side. Thus it may be said to a very good degree of approximation that this component B is independent, both in phase and in magnitude, of the total load current.

In order to find the third component, assume that the ratios of transformation are equal and that the equivalent resistance and the equivalent reactance of each transformer are adjusted so that, although their equivalent admittances remain unchanged, the ratio of resistance to reactance is the same for each. In this case the component B is zero and the current in the first transformer is given by equation (1). Since the ratios of resistance to reactance are the same for each of the transformers, the currents are all in time-phase and the ratio, $\frac{y_1}{Y_0}$, is the same as the ratio of the numerical value of the admittance of the first to the sum of the numerical values of the admittances of the several transformers.

This latter ratio will be expressed thus: $\left[\frac{y_1}{\Sigma y} \right]$

One may then write $I_1 = \left[\frac{y_1}{\Sigma y} \right] I_0$ (4)

The third component, C, of the current in the first transformer is the difference between equations (1) and (4) and is:

$$C = \left\{ \frac{y_1}{Y_0} - \left[\frac{y_1}{\Sigma y} \right] \right\} I_0 \quad (5)$$

This component is in general neither in time-phase nor in time-quadrature with the total load current I_0. It is zero when the ratios of equivalent resistance to equivalent reactance are the same for all of the transformers.

Assume that the components B and C are zero, so that the actual current in the first transformer is given by equation (4). The current in any transformer will at all times be proportional to the total load current. If the transformers are suited for ideal parallel operation, each will carry its maximum allowable current at the time when the total load is a maximum. Let I_1', I_2', etc., be the maximum allowable currents for the transformers. These may or may not be the rated values of the full-load currents, as some transformers may be rated more conservatively than others. In want of better data, however, they should be taken as such. In this case the equation need not be in complex notation since all of the current vectors are in time-phase. The total maximum possible load current is the sum of the currents in the several transformers and is

$$\Sigma I' = I_1' + I_2' +$$

The proportion of this that the first transformer should take at this full-load condition is $\frac{I_1'}{\Sigma I'}$, and hence this is the proportion of the total load current that this transformer should take at all times. This may be called the ideal current A.

$$A = \frac{I_1'}{\Sigma I'} I_0 \quad (6)$$

This is the first and most important of the components into which the actual current is divided.

The fourth component, D, is the difference between the actual current when the ratios of tranformation and the ratios of equivalent resistance to equivalent reactance are equal for all of the transformers and the current which would exist under the ideal condition. That is, it is the difference between the values given in equations (4) and (6).

$$D = \left\{ \left[\frac{y_1}{\Sigma y} \right] - \left[\frac{I_1'}{\Sigma I'} \right] \right\} I_0 \quad (7)$$

If the impedance volts are the same for all of the transformers at the time they are carrying their maximum allowable current, this component, D, is zero.

The actual current may now be expressed as the sum of its four components. That is:

$$I_1 = A_1 + B_1 + C_1 + D_1$$

$$I_1 = \left[\frac{I_1'}{\Sigma I'} \right] I_0 + y \left(V_1 - \frac{I_0}{Y_0} \right) \left(1 - a_1 \frac{Y_0}{\Sigma a y} \right) + \left\{ \frac{y_1}{Y_0} - \left[\frac{y_1}{\Sigma y} \right] \right\} I_0$$

*If $I_1 = 0$, and $I_2 = I_0$

$$I_0 = \frac{a_1 - a_2}{a_1} V_1 y_2$$

Under any ordinary conditions this would be a very small current at a very low power-factor.

$$+\left\{\left[\frac{y_1}{\Sigma y}\right]-\left[\frac{I_1'}{\Sigma I'}\right]\right\}I_o \qquad (8)$$

If the value of the actual current is desired, it is best found by solving equation (3), and it is only when we wish to determine the effect of the several components that it is necessary to use equation (8). To repeat, the first component is the current which would exist if the transformers were suited for ideal parallel operation. The second component is zero if the ratios of transformation are equal. This component is practically independent of the total load on the transformers so that its phase relation with respect to the load current depends upon the power-factor of the load. The third component is zero if the ratios of equivalent resistance to equivalent reactance are equal. It is directly proportional to the total load and may either lead or lag the resultant current. The fourth and last component is zero if the transformers have the same equivalent impedance volts for maximum allowable current. It is also directly proportional to the total load and may be either in time-phase or in time-opposition to the resultant current. When three or more transformers are operating in parallel it is possible to have the components B, C and D present in two of them and absent in the others.

The vector diagram which shows the phase relations of these components with respect to the total load current is given in Fig. 2. The diagram is drawn for two transformers. The component D is always in phase or in opposition to the ideal current, while the component C is in practice nearly in quadrature with it. The sum of their quadrature components for all the transformers must of course be zero. The vector sum

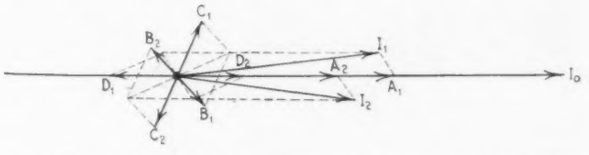


FIG. 2—VECTOR DIAGRAM SHOWING PHASE RELATIONS OF COMPONENTS

of each of the components B, C and D for all of the transformers is also zero. That is:

$$\Sigma B = 0,\ \Sigma C = 0,\ \Sigma D = 0;\ \text{but}\ \Sigma A = I_o.$$

Since in the aggregate none of these components except A appears in the line, they may be called "local currents."

Under the assumption of a practically constant core loss, the output of any transformer is determined by the current it carries. It is thus important to find the effect of each of these components on the copper loss. The effect of the component D is simplest to find. If the components B and C are both zero, the total current is:

$$I_1 = A_1 + D_1.$$

The component D may be either in time-phase with or in time-opposition to the component A. The heating due to the current is proportional to I_1^2 or to $(A_1^2 + 2A_1D_1 + D_1^2)$. The additional heating due to the component D is proportional to $(2A_1D_1 + D_1^2)$, and the fractional increase is proportional to $\left(\frac{2D_1}{A_1} + \frac{D_1^2}{A_1^2}\right)$.

In actual practice the first term of this expression would probably in most cases be greater than the second and so would determine the sign of the expression; that is, D may be either a positive or a negative quantity. Observe that the additional heating due to this component is far from being proportional to the square of its value. Thus, owing to the inequality of the equivalent impedance volts at maximum allowable current, the heating in some transformers is greater and in some is less than it should be, so that some transformers will reach their limit of permissible output before the others.

The other components, B and C, are in general neither in time-phase nor in time-quadrature with the total load current, and the additional heating produced by each of them may be found by the same method of analysis. The additional heating produced by the component of the current which is caused either by the inequality in the ratios of transformation or in the ratios of equivalent resistance to equivalent reactance likewise is not proportional to the square of this component.

Since the phase relation of the second component B with respect to the load current I_o depends upon the power-factor of the load, the additional heating which it causes will also depend upon the power-factor of the load. The additional heating caused by the other components, C and D, is independent of the power-factor. If the proper amounts of resistance and reactance are added to each of the transformers these latter components, C and D, can be reduced to zero in every transformer for all conditions of load. At certain loads the additional heating caused by the component B may be zero in at least one transformer. But this component will disappear in all of the transformers only when the number of turns in the primary and secondary coils are altered so that they are in the same ratio for all transformers.

The determination of the effect that these components have on the total output of the transformers, together with a numerical example, will be given in a later issue.

Central-Station Service for Constantinople

The conveniences of electricity are soon to be made available in the Turkish capital and the devout Mussulman may shortly exchange his piastres for the kilowatt-hours of enlightenment and progress. Heretofore Constantinople has had no central-station electric-lighting system, although a few buildings such as apartment houses, hotels and office structures had private plants of their own. A foreign syndicate, La Société Anonyme d'Électricité Ganz, of Budapest, Hungary, is now installing a modern plant to furnish lighting and motor service for the city generally. Some of the equipment was purchased in America. A complete telephone system is also being installed, and the street-railway company is now engaged in electrifying its lines.

New Field of Education for Engineering Universities

Certain American universities are now making a practice of allowing their professors of engineering to engage in outside professional work, some even going so far as to require men of their teaching staff to keep in close touch with the problems of public utility regulation. The regents of the University of Michigan recently declared that such teachers "not only should be permitted to engage in professional work outside of their university work, but should be encouraged to engage in such work, in so far as it can add to the effectiveness of their work as teachers and does not impair their services to the university, and where such work relates to problems of public interest the special kinds of skill to be found in such a teaching staff should, as far as posible, be made available to all."

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

"Can I Be of Further Service?"

Among the employees of the Southern California Edison Company the habit of showing a personal interest in customers' problems is encouraged. When called to take care of any trouble the repairman, after the complaint has been attended to, personally informs the consumer that the repair has been made and asks pleasantly if there is anything else that needs looking after. Customers of the company in the Venice (Cal.) district seem to appreciate that kind of attention.

Pension System of Northern Illinois Company

On Jan. 1 a pension system similar to that of the Commonwealth Edison Company was announced by the Public Service Company of Northern Illinois. Pensions are given to three classes of employees—those at least fifty-five years old who have worked thirty years for the company; those at least sixty years old whose service is twenty years, and those at least sixty-five years old who have a record of fifteen years of service. In computing the annuity that consecutive five-year period when the employee received his highest salary is taken as the basis. The average pay for that period is multiplied by the number of years of service, and the annuity is 1.5 per cent of the product.

Wiring on Monthly Payments in Kansas City

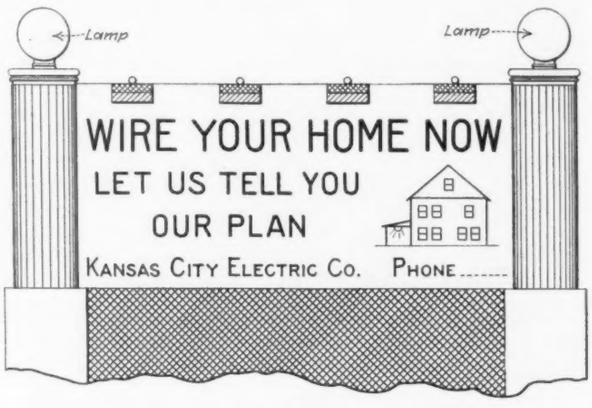
During the last thirty months the Kansas City (Mo.) Electric Light Company has been financing prospective customers who cannot afford to pay the entire cost of a wiring installation at the completion of the job. According to the plan in force, the contracts secured by the lighting company's solicitors are awarded in rotation to three contractors in the city, each contractor receiving every third job regardless of its size or character. These firms do the work and at the completion of the installation are paid in full by the lighting company. The new customer then has the privilege of paying the electric-service company for the wiring in twelve equal monthly payments.

Surprise, however, has been occasioned by the fact that, although the company offers to finance customers for a period of twelve months, the majority of the accounts are in reality settled in full within periods of from three to four months. When the present system of financing customers' installations was adopted it was estimated that by this time the company would have $100,000 invested in wiring, but, owing to the desire of customers to pay in full, the sum involved is now only approximately $20,000. The wiring business has been good, some 2600 houses having been equipped within the thirty-month period, and Mr. Louis H. Egan, general manager of the company, points to the above figures as evidence that the time allowed for payments need not be extended over one year.

Success of Illuminated Sign Exchange Plan at Kansas City, Mo.

As described in the *Electrical World* of July 5, 1913, the Kansas City (Mo.) Electric Light Company has an agreement with the Thomas Cusack Sign Company whereby the electric-service company lights 250 linear ft. of signboards upon which its advertisements are painted by the sign company. As soon as one display space is sold to a customer desiring a lighted board the lighting company's sign is transferred to another board, still retaining 250 ft. of space.

Throughout the last six months the success of the



ELECTRIC-LIGHTED BILLBOARD, KANSAS CITY, MO.

plan has been marked, for no sooner has the electric service company occupied and lighted a board than it has been demanded by some prospective advertiser. The lighted billboard space is more than 3000 linear ft.

Recently an endeavor has been made to add artistic quality to the advertising space, the boards being erected between pillars bearing electric lamps in diffusing globes. In the open spaces formerly left void beneath the painted panels lattice is now used to hide the unsightly wooden framing. Indirect illumination of the boards is furnished by tungsten lamps in reflectors supported on pipe framing.

A Ball to Finance "White-Way" Lighting

The town of Red Lake Falls, Minn., which obtains its electricity from the Red River Power Company, of Grand Forks, N. D., developed a new method for financing its "white-way" installation. This was by means of a "white-way" ball, with tickets at $5 each.

The city of Minot, N. D., in addition to renewing its street-lighting contract with the Consumers' Power Company, has recently made arrangements for the supply of energy for the operation of a new "white-way" lighting system at Minot, consisting of sixty ornamental standards, each carrying one 60-watt lamp and four 40-watt lamps.

Central-Station Service in Milwaukee's Newest Hotel

Mr. G. E. Bernecker, contract agent for the Commonwealth Power Company, Milwaukee, Wis., is authority for the statement that the company's load has been doubled practically within a year, and further, that of Milwaukee's large downtown hotels only two remain which are not served from the circuits of the Commonwealth Power Company.

Two months ago the new Hotel Wisconsin was opened, adding approximately 600 kw of connected load to the central-station lines. Of this load about 470 hp is in motors and the remainder in lamps.

For lighting the main lobby, dining rooms, ballroom and other principal public places indirect fixtures and ornamental hanging lanterns are employed. Particularly harmonious lighting effects have been obtained in

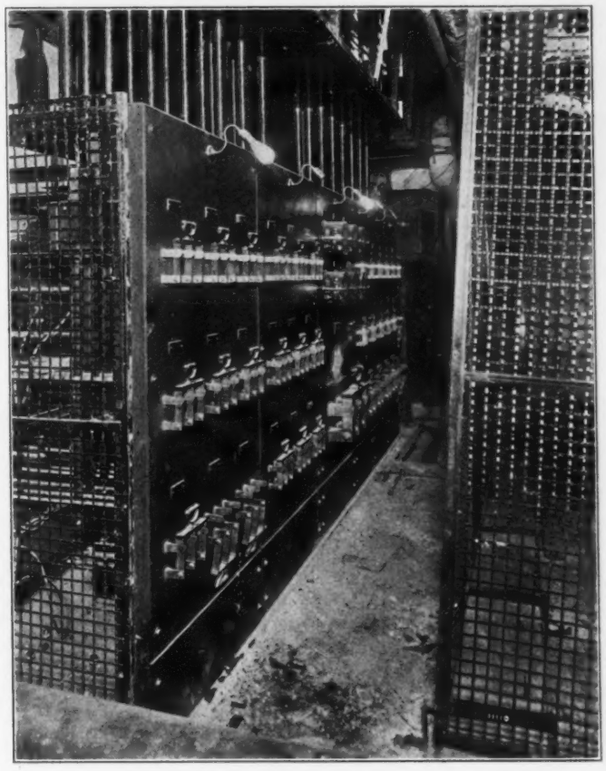


FIG. 1—230-VOLT SWITCHBOARD IN HOTEL WISCONSIN, MILWAUKEE

the lobby, where hanging lanterns of oak and art glass are used. Candelabra side lamps about the lobby add to the effect.

Central-station service enters the building underground from the downtown substations of the company over a three-wire, 230-volt direct-current system. Inside the structure energy is distributed from a switchboard designed by Holabird & Roche, the architects, Chicago, and built by George F. Rohn, Milwaukee. The construction employed is of interest in that all horizontal leads from the switches to the interconnecting busbars are insulated in round fiber tubes. A few of these tubular insulators may be seen in Fig. 1 through the iron wicker-work incasing the switchboard.

The largest motor in the installation is the 80-hp, 220-volt Allis-Chalmers machine shown in Fig. 2, driving the 50-ton Vilter ammonia compressor. Although no ice is frozen in the building, refrigeration is furnished for the various cold-storage rooms and for the air coolers which will be used in summer time. Centrifugal brine pumps for the refrigerating system have been installed in duplicate, the two units being driven by 5-hp, 220-volt Watson motors. Two 5-hp motor-driven pumping sets circulate ice water to all the rooms, while water for ordinary house service is supplied to the twelve floors by two 20-hp triplex pumps.

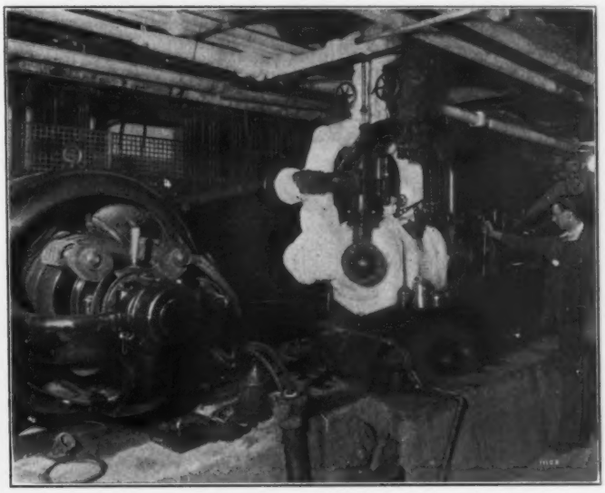


FIG. 2—REFRIGERATING EQUIPMENT

The hotel is heated with steam from the central-station company's low-pressure mains. Two 7.5-hp Watson motors are installed to pump a partial vacuum on the exhaust side of the local heating system, thus increasing the speed of the steam flow. Three 5-hp Wagner motors pump waste water and sewage from the basements of the hotel situated below the drainage level. In the kitchen motors are employed, ranging from 0.5 hp to 5 hp in rating, for washing dishes, chopping meat, peeling and mashing potatoes and polishing silverware. The laundry likewise is electrically equipped, one 15-hp motor driving washing machines from a line shaft, two

FIG. 3—ELEVATOR MOTOR AND CONTROL APPARATUS

5-hp motors driving rough-dry tumblers, and a 1-hp motor driving a mangler.

Five 40-hp Westinghouse motors automatically driven by Cutler-Hammer control apparatus operate the main elevators for the hotel. The control apparatus and a portion of this battery of machines are shown in Fig. 3. In addition to these elevators, one 20-hp

Westinghouse motor is used for driving an alley hoist for handling baggage and trunks.

The ventilating system of the hotel is equipped with two 7.5-hp and three 5-hp Allis-Chalmers motors driving the fans on the twelfth floor near the air intake. One 7.5-hp and two 5-hp motors supply water to the air washers connected to this ventilating system.

A feature of the electrical service in this hotel is the use of the telautograph. By means of this device the clerk can write orders at his desk which are instantly delivered in his own handwriting to the linen room, kitchen, dining room or engine room, the message being recorded whether the person in charge of these departments is present at the time or not.

Lighting in the upper corridors and individual rooms has been carefully laid out in the effort to procure both economical light distribution and the greatest convenience to guests. Switches in each corridor permit the lamps in the halls to be lighted in alternate groups or all together. In addition to the usual lighting equipment in the individual rooms, an additional flush socket is installed in each for guests who wish to use a reading lamp or an electric appliance of any sort.

Mr. G. H. Travis, chief engineer of the establishment, points out that no coal is burned in this hotel, as lighting, heating and motor service are all furnished from the electric and steam mains of the Commonwealth Power Company, while cooking in the main kitchen is done on gas ranges.

A Perambulating Lamp Carton

The float shown herewith, representing a huge tungsten-lamp carton, served as an effective advertisement for the Citizens' Light & Power Company, of Adrian, Mich., in an industrial parade held recently in that city. The giant carton, painted with its familiar colors, measured 13 ft. by 8 ft. by 6 ft. and was carried on an electric runabout. Much of the attention which this

FLOAT USED IN INDUSTRIAL PARADE IN ADRIAN, MICH.

float received was attributed to the concealment of its means of propulsion and to the noiseless operation of the electric vehicle inside it.

Quoting the words of Mr. H. A. Fee, manager of the company, "it was the most effective piece of straight advertising in the parade." After being removed from the electric runabout, the carton was hoisted to the roof of the Citizens' Light Company's office building, where it attracted additional attention until destroyed by the big storm which recently did so much damage on Lake Huron.

Meter Regulations and Rules in Various States

Mr. F. A. Vaughn, chairman of the committee on electric-service rules revision, made an interesting report to the Wisconsin Electrical Association at the convention in Milwaukee on Jan. 15. He spoke of the rules for electric service of the Railroad Commission of Wisconsin, which were put in force Oct. 9, 1913, as an excellent compilation of its kind. Other states are copying these rules and in some cases making changes which are less desirable from the point of view of electrical utilities. There is a widespread tendency throughout the country to follow the standards set by the Railroad Commission of Wisconsin. Mr. Vaughn recommended that the association should have a standing committee on meters and rules to co-operate with the committees of other state associations and with those of national organizations, so that a uniform, standardized system of service regulations may be developed. The Wisconsin association continued its committee, of which Mr. Vaughn is chairman. Mr. S. B. Way and Mr. George Allison, of Milwaukee, are the other members of the committee.

In his report Mr. Vaughn referred to the work done by the National Electric Light Association and the Association of Edison Illuminating Companies. He spoke of the "Code for Electricity Meters" and the "Electrical Meterman's Handbook," with which the Wisconsin commission's rules and those of the two commissions in New York State comply almost to minute detail.

Recently the Wisconsin rules were adopted in West Virginia, except that a comparatively slight change was made by which it is the duty of the State to seal all meters. Therefore, as in Canada, the utilities do not know the condition of their own meters unless they have reason to have confidence in the State's engineers. A vigorous protest against this feature of the rules is being made in West Virginia.

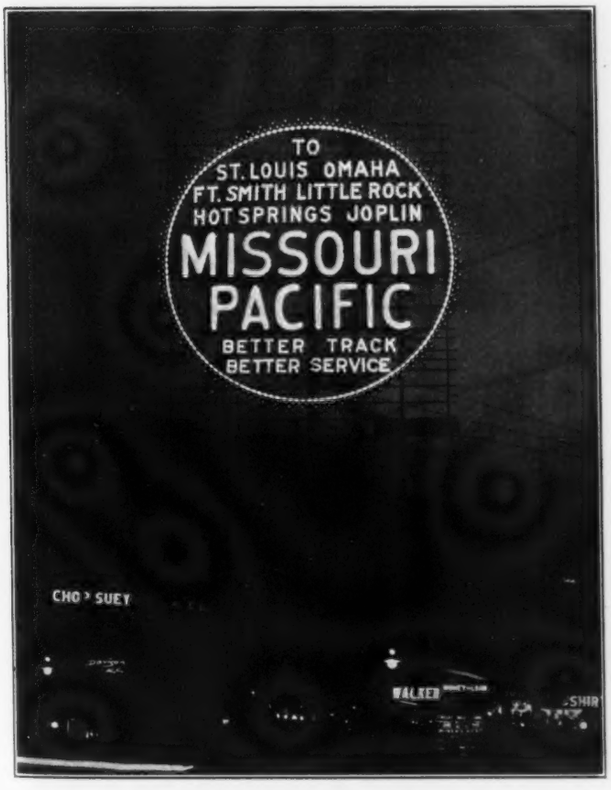
Mr. Vaughn pointed out that the commission for the Second District of New York recently made a ruling which unintentionally precludes the possibility of ever using an ampere-hour meter in that district for the measurement of energy. The commission has indicated more recently that it did not intend to make such a broad ruling. It may be possible to find a remedy. On this point Mr. Vaughn says: "This last error is a serious one in view of recent developments in ampere-hour meters here and abroad and the thorough discussion that is going on in the national association's committee on meters, as well as the interested attitude of the Wisconsin commission in the possible use of the ampere-hour meter for a large number of places where an inexpensive meter is desirable and probably practicable."

The interesting announcement was made that the committee on meters of the National Electric Light Association expects to divide the United States and Canada into seven geographical sections, one for each member of the committee. By keeping in touch with the chairman of the committees on meters of the state associations, and also with the public policy and rate research committees of the N. E. L. A., and with other authorities, it is hoped that the N. E. L. A. meter committee will be able to foresee and participate in any movement preparatory to making service rules by any state commission.

In the original draft of rules for electric service of the Railroad Commission of Wisconsin there was one—tentative Rule 28—intended to provide that maximum-demand instruments or indicators should be tested in as careful a manner as would be required for a watt-hour meter for an installation of the same size. The Wisconsin committee saw that no demand indicators on the market could be adjusted to comply with this rule. A promise to make strenuous attempts to standardize the practice and develop better meters through the manufacturers caused the commission to strike out, for the time being, tentative Rule 28 and withhold further rulings on maximum-demand indicators for approximately one year, when the various committees on meters will be able to report the progress of development. The National Electric Light Association has undertaken an exhaustive investigation of the characteristics of maximum-demand meters. When this work is completed and practice becomes more uniform and meters are developed capable of performing certain functions under given conditions, it may be safe to frame a substitute for tentative Rule 28.

Railroad's Large Electric Sign, Kansas City, Mo.

Now that the railroads are beginning to realize the value of electric-sign advertising, some of them are rapidly becoming good customers of the electric-service companies in the territory which they traverse. One of the large signs erected recently in Kansas City, Mo.,

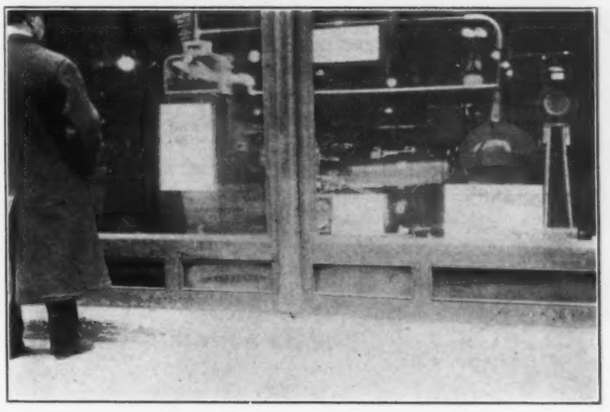


LARGE RAILROAD SIGN

sears the night sky with illuminated claims for the better track and better service of the Missouri Pacific Railroad to points south, east and west of Kansas City. The text of the sign is inscribed in a 60-ft. circle of colored lamps which may be seen for a great distance. There are about 900 lamps in the sign, most of which are 5-watt tungsten and 4-cp carbon units.

Educational Window Display

The People's Light Company, operating electric, gas and steam-heating properties at Davenport, Ia., recently made use of a window display in its office which was intended to be of educational interest to the company's patrons in any branch of its service. Electrical energy



WINDOW DISPLAY, DAVENPORT, IA.

taken through a meter mounted in the window drove a small reciprocating air-lift pump, the air intake for the pump being conducted through a gas meter. The air was then used to lift the water through the piping shown in the illustration and through the steam meter at the left. Thus the three meters—one registering electrical energy consumed by the motor, the gas meter registering air taken through the air-lift pump, and the steam meter registering water—were shown in operation before the eyes of the public. Glass tubing used instead of pipe showed the travel of the water and placards explained the other operations. Disassembled meters were placed on the floor of the show window.

New-Business Development at Kokomo, Ind.

The Indiana Railway & Light Company, which operates a central station at Kokomo, Ind., supplying service to a population of approximately 25,000, including Kokomo and several smaller towns in the immediate vicinity, has issued its annual report on the connected load of its lighting and power department for the year ended Dec. 31, 1913. Among the figures submitted are those given in the accompanying table:

DATA FROM ANNUAL REPORT OF INDIANA RAILWAY & LIGHT COMPANY

Class	December 31, 1912	December 31, 1913	Gain	Percentage
Commercial customers	705	864	159	22
Residence customers	1997	2677	680	33
Motor-service customers	148	179	31	20
Total	2850	3720	870	30
Street-lighting series 7-amp arcs	253	269	16	7
Street lighting series 100-watt tungsten	0	49	49	..
Motor hp	2309	2888	579	25
Electric irons	950	1755	805	84

Plans have been outlined for the coming year for extensive rural development. Efforts will be made to extend electric service to at least 200 farmers during 1914. Mr. O. M. Booher is manager of the new-business department.

Illumination and Wiring

A Formula for Distribution-Line Extensions

In making distribution-line extensions most central-station companies at present follow the practice of requiring that the estimated yearly gross revenue for one or more years from the extension contemplated must be equal to or greater than the cost of the extension, not including meters, transformers and service drops. The fallacy of this rule, as pointed out by Mr. H. G. D. Nutting, assistant to Mr. Smith, of the Clement C. Smith properties, Milwaukee, Wis., in a paper before the recent Wisconsin convention, is evident from the fact that the cost of operating a new extension is not a function of the partial investment alone.

The proper extension policy, asserted the speaker, should be such as to make the natural development of the business the maximum, most continuous and ultimate possible for the benefit of both the central station and the community served. Such a condition, said Mr. Nutting, is expressed by the formula $R = aI + bL + cM + dT + frK$, in which R is the gross yearly revenue in dollars that must be received from the new extension to make it pay; I is the cost of the extension in dollars, including meters, transformers, poles, wires and all apparatus required; L the actual length of wire used, measured in feet regardless of size of wire; M the number of prospective meters or consumers to be connected; T the number of transformers that will be required, regardless of size; r the cost of kilowatt-hours at the station switchboard (including, say, 10 per cent profit), and K the estimated kilowatt-hours which will be delivered to the extension per year.

The fifth term of the formula, rk, should be selected with care as, standing alone, it represents the absolute minimum rate at which electricity can be sold without a continuous loss. The value of f (the per cent loss) can be approximately found for most stations. Even though it may vary from 10 per cent to 50 per cent, it will not affect the results much. It usually runs from 20 per cent to 30 per cent.

Factors Constant for a Given Plant

The coefficients a, b, c, d and f are variables which become constant for any given central station as explained below.

First, a represents the sum of the rates of interest, profit, depreciation and taxes for the particular utility, expressed as a decimal. For example:

Rate of interest and profit	0.075
Rate of depreciation on line	0.100
Rate of taxation	0.025
a =	0.200

Next, b equals the cost per year of operating and maintaining 1 ft. of wire regardless of size. This includes miscellaneous distribution system, operating labor and supplies and expenses and also the maintenance of overhead lines. The value of b for any particular utility is arrived at by dividing the above annual distribution system expenses by the number of feet of wire operated, both primary and secondary.

The cost per consumer (or meter) per year for meter and miscellaneous expenses is represented by c and includes labor of removing and resetting meters, labor of inspecting and testing meters, meter department supplies and expenses, maintenance of meters, consumption expenses, such as lamp renewals, consumers' premises expenses, etc.; commercial expenses, such as cost of collecting, reading meters, promotion of business, etc.; general expenses, such as salaries of general officers, law expenses, maintenance of general office, etc.; undistributed expenses, such as injuries and damages, insurance, utility equipment expenses, etc.

The value of c for any utility is arrived at by dividing the sum of the above-mentioned expenses by the present number of consumers. It will be found that this is one of the largest factors in the formula.

Coming to d, this equals the cost per transformer per year and includes labor of inspecting, removing and resetting transformers and the maintenance of transformers. The d item is arrived at by dividing the above expenses by the number of transformers in use.

Again f = unity plus the average percentage of loss and unaccounted-for energy in the distribution system, expressed as a constant. Thus, if the loss is 30 per cent, $f = 1 + 0.30 = 1.3$.

Applying the formula to a proposed extension in the case of a specific utility where

$a = 0.20$ $b = \$0.003$ $c = \$10.00$
$d = \$1.50$ $f = 1.3$ $r = \$0.015$

it becomes

$$R = 0.2I + 0.003L + 10M + 1.5T + 0.0195K$$

Although at first sight the formula may seem complicated, when it is realized that it is merely the sum of the various expenses contributing to the cost of operating the new extension, its simplicity will be evident.

Application of the Formula

A case involving six prospective customers is cited in which

I (the investment) = \$500
L (the length of wire) = 5000 ft.
M (the number of consumers) = 6
T (the number of transformers) = 1
K (the kilowatt-hours delivered) = 900 (estimated)

Then

$$R = 0.2\,(500) + 0.003\,(5000) + 10\,(6) + 1.5(1) + 0.0195\,(900)$$
$$= \$100 + \$15 + \$60 + \$1.50 + \$5.85$$
$$= \$193.95$$

This means that, barring prospective further business from this extension, it cannot profitably be made unless the six prospective customers will guarantee \$194 a year, or \$32.33 each.

Again, it will be interesting to apply the formula to the simple case of a service drop from a secondary line where

$I = \$10$ $M = 1$ $K = 150$
$L = 100$ ft. $T = 0$

Using the formula:

$$R = 0.2I + 0.003\,L + M + 1.5\,T + 0.0195\,K$$
$$R = 0.2\,(10) + 0.003\,(100) + 1 + 0 + 0.0195\,(150)$$
$$= \$2 + \$0.30 + \$1 + \$2.92$$
$$= \$6.22$$

This will be the minimum amount the customer must pay annually to permit of the extension meeting its cost, not including energy consumption, commercial, general and undistributed expenses. If these latter are included, the cost will be about \$15.

It is evident from the foregoing that the degree of conservatism a company wishes to pursue is contained in the value of c used. c will vary from 1 to 15 in different cities, depending on circumstances as set forth previously.

Applying the Formula to the Future

While no one, observed Mr. Nutting, can predict accurately the future, knowledge of statistics and tendencies in certain sections of cities will, however, enable a manager to pass fairly reliable judgment as to the number of customers likely to be added in that territory in a certain number of years. The application of the

formula to this condition will be illustrated by an example in which five applicants for electric service required the following conditions to be met in order to serve them:

$I = \$400 \qquad M = 5 \qquad K = 750$

$L = 4000 \text{ ft.} \qquad T = 1$

$$R = 0.2\ (400) + 0.003\ (4000) + (1)\ 5 + 1.5\ (1) + 0.0195\ (750)$$
$$= 80 + 12 + 5 + 1.50 + 14.60$$
$$= \$113.10$$

The estimated value of R equaled \$90, meaning that \$23.10 a year would be lost on this extension.

If there is reason, however, to believe that in three years six more customers could be added without further line extensions, one may apply the formula to the extensions under these conditions as if they were immediate, thus:

$$R = 0.2\ (472) + 0.003\ (4600) + (1)\ 11 + 1.5 + 0.0195\ (1650)$$
$$= 94.40 + 13.80 + 11 + 1.50 + 32.20$$
$$= 152.90$$

Estimated $R = 11 \times \$18 = \$198$, which is \$45.10 per year more than the cost of serving the eleven customers.

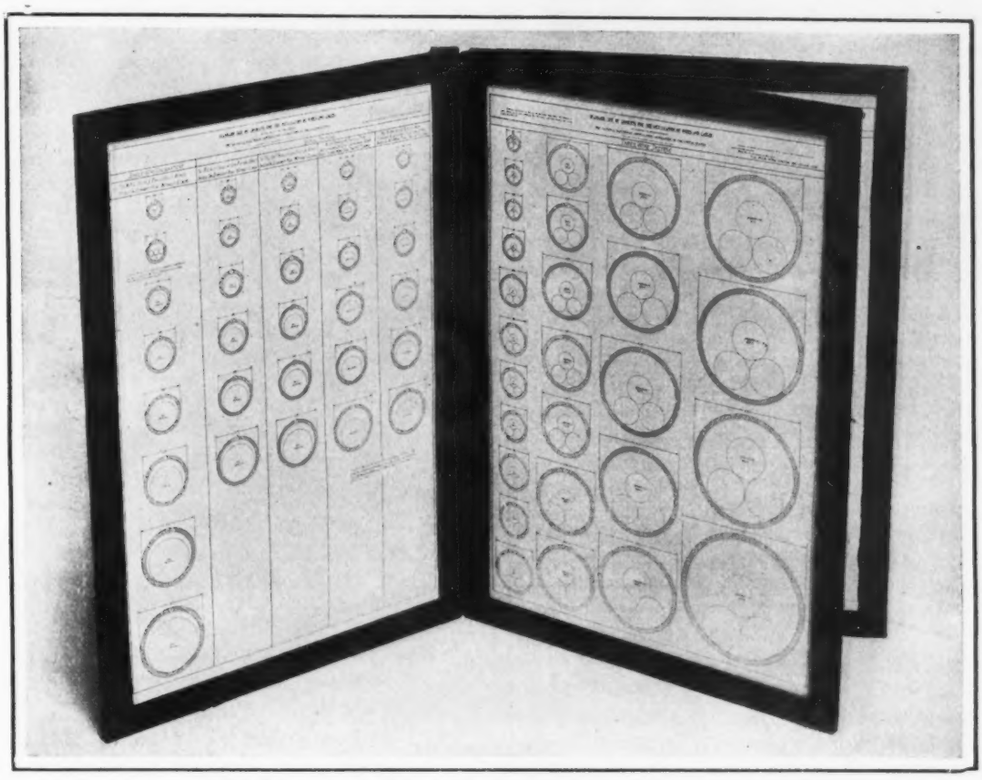
On the original extension for five customers the company would lose $3 \times 23.10 = \$69.30$ in three years. Evidently from the above calculations, this loss (including interest) would be made up in approximately one and one-half years after the six additional customers came on. In view of this it is advisable to make the original extension for five customers, notwithstanding the fact that the requirements of the first conditions are not satisfied.

While the above formula can be applied under almost every condition met with in central-station practice, asserted Mr. Nutting, he cautioned that it should not be used indiscriminately. Any practical rule requires the exercise of fair judgment. The principal value of a formula of this kind is that if any changes or modifications are made in its terms the conditions accompanying the change are completely known. Furthermore, the degree to which any factor may be changed is apparent, and the results can be anticipated.

Standard Sizes of Conduit for Wires and Cables

Recognizing the desirability of accurate data on the proper size of conduit to be used in installing wires and cables, the National Electrical Contractors' Association has prepared a set of six charts giving this information in detail by means of full-size sketches.

In the past there has been a disposition to use conduits of too small interior diameter. In the present charts, therefore, care has been taken to recommend conduits of sufficient size to cover all working conditions, at the same time avoiding extravagant sizes. The charts were prepared after careful study of actual conditions and have been officially adopted by the National Electrical Contractors' Association. Conduits and conductors are shown full size in addition to giving the actual external diameter of the conduit and the carrying capacity of the wires used in accordance with the changes which have been recently made in the National Code.



CHARTS SHOWING SIZES OF CONDUITS FOR WIRES AND CABLES

The charts are substantially mounted in wooden frames hinged together and provided with a backing board for convenient hanging. There will be three in the complete set, two charts being mounted on each sheet, and each chart is marked with the name of the system shown on the reverse side.

The National Electrical Contractors' Association has borne the work and expense of preparing these charts and in the interest of standardization is prepared to furnish the sets at cost, \$3 per set, from its headquarters at Utica, N. Y.

Ornamental Tungsten Lighting, Menominee, Mich.

So large a percentage of the merchants on the main street of Menomineee, Mich., have accepted the liberal street-lighting offer of the Menominee & Marinette Light & Traction Company that an almost continuous "white way" has been created along the city's thoroughfare. Ornamental standards of the type shown in the accompanying night scene are furnished to patrons of the central-station company under one of two contracts. In one the company agrees to purchase, install and

ORNAMENTAL TUNGSTEN LIGHTING

operate the units, the customer paying the electric-service company $3.10 per post per month. Later, if the customer wishes to purchase the ornamental standard himself, a monthly charge of $2.60 is made for its operation.

Each standard carries one 100-watt lamp and four 60-watt lamps. Operating from dusk till midnight it is estimated that the lamps will be turned on for about 2200 hours per year. At this rate the energy consumed by the units will net the company about 4 cents per kw-hr.

Recent Telephone Patents

A new transmitter which has been patented by Mr. H. C. Egerton, of Passaic, N. J., is assigned to the Western Electric Company. The diaphragm carries the movable electrodes, while the stationary electrodes are carried in heavy metal blocks, one on each side of the diaphragm. The blocks are recessed to form cups, the electrodes being at the bottom of the cups. The lips of the cup bear against felt washers, which in turn bear upon the diaphragm to seal the cup.

Mr. W. B. Oliver, of Collingswood, N. J., has patented a very sensitive transmitter for use of the deaf. This adjustable instrument he calls a micro-telephone. A carbon block forms the rear electrode, the front being a carbon diaphragm. The carbon block contains several recesses which contain carbon granules, the latter bearing upon both electrodes. Provision is made for adjusting the space relation of the two electrodes, and a screw is projected into the bottom of each recess so that the space remaining for granules may be adjusted. The patent has been assigned to the Oliver Electric Company.

Another device for the use of the deaf has been patented by Mr. K. M. Turner, of Jamaica, N. Y., and consists of a lady's handbag within which is carried an acousticon instrument. The transmitting part of the device is placed directly behind a perforated section of the bag. Two registering notches in the frame of the handbag permit the passage of a receiver cord.

Letters to the Editors

Ozone Machines and Public Health

To the Editors of the Electrical World:

SIRS:—In further reference to the subject of "Ozone Machines and Public Health," treated in your issues dated Nov. 15 and Nov. 29, 1913, there is one point that has not been brought out which seems to me to be a vital one. It is this: Will ozone in concentrations agreeable to the human organism kill the bacteria that are ejected into the air when a person suffering from tuberculosis or other diseases of the respiratory passages coughs or sneezes?

In the act of coughing or sneezing considerable mucus, laden with germs, is projected in a finely divided state or in minute bubbles so that it will float in the air for some time and can be breathed by persons near by, and in all probability it is by this means that such diseases are commonly propagated in public.

The bacteria so given off are moist and growing instead of dormant, as is the case where they have been dried, and in such condition it would seem that they should be acted upon somewhat as if they were in water.

If experiment should show that the moist germs of tuberculosis or other respiratory diseases can be destroyed under the above conditions by a concentration of ozone that is not disagreeable, then there could be no doubt as to its value in preventing the spread of infection in schoolrooms and other places of public gathering.

In all probability not much can be expected of ozone as a curative agent in diseases of the respiratory tract, for in most of such diseases the active germs are so covered by mucus that they are well protected. Nor can we expect the ozone machine to become a popular piece of household furniture, even if it should be proved that ozone will kill moist germs floating in the air, for the diseases mentioned are still very generally handed around the family through kissing or other contacts, and until we observe privately some of the precautions that we now commonly observe publicly, family colds will be as popular as at present, and the ozone machine but a useless piece of bric-à-brac.

Adrian, Mich. H. A. FEE.

Electric Service, Energy and Charges

To the Editors of the Electrical World:

SIRS:—I do not quite follow the reasoning of Mr. C. E. Wendell, who, in discussing energy charges in your issue dated Jan. 10, 1914, says that since it is cheaper to operate one isolated plant rather than two adjoining plants, therefore central stations should serve isolated plants at a rate somewhat less than they can manufacture the energy themselves. There seems to be a flaw in his reasoning. When two isolated plants are combined, all of the services offered by the two are combined; that is, the new plant supplies not only electricity, but heat, refrigeration, engineer's services and general supervision of machinery. On the other hand, a central station supplies electricity only.

I think it has never been questioned that the central station can manufacture electricity at the switchboard more cheaply than the private power plant, with the possible exception of the large internal-combustion engine plant; but this has little to do with the case, because the manufacturing cost is a small proportion of the total cost to the consumer and the service supplied

by the central station is only one of the many services supplied by the isolated plant.

I have no quarrel with a rate based upon maximum demand *at the period of the maximum demand on the central station*, but can there be any possible justification for a rate based on quantity of energy used other than a reasonable allowance for the extra cost of billing, metering and collecting, with such incidental service as the supply of lamps and testing of meters? By rate based upon maximum demand, I mean a uniform rate to large and small consumers for electricity used during the peak-load period, which may usually be considered to be from 4 p. m. to 9 p. m. during the months of November, December, January and February, and another uniform rate for electricity used during all other periods. The cost of billing, metering and collecting, etc., might be covered by a separate uniform charge per consumer, but experience in the sale of other public utilities is against this practice.

Interesting results are obtained from a study of the actual profit on the wholesale business taken by central stations. On any reasonable basis of allowance for fixed charges caused by the maximum demand of wholesale customers in New York City the profit to the central-station company is almost negligible, and the same investment applied to developing retail consumption would have resulted in a far larger profit to the company itself while at the same time the isolated plants would have gone in where they logically belong —in large buildings where a great demand exists for heat and other services as well as electricity. As a matter of fact, the whole amount of the profit derived from the wholesale business could be derived by the central stations in New York City from the business now supplied by isolated plants during summer months if the central stations were to offer a rate sufficiently attractive to cause isolated plants to shut down during the summer months, as they could very well do, because no investment whatever would be required. I firmly believe that the solution of the problem will be along the lines of co-operation rather than competition.

New York, N. Y. P. R. MOSES.

What the Service Will Bear

To the Editors of the Electrical World:

SIRS:—At a recent hearing before one of the state public service commissions, in an application for a reduction of the rate on gas for lighting service, the commissioner before whom the hearing was held is reported to have said that inasmuch as the gas for lighting purposes was the same in quality and was delivered through the same pipes as the gas used for fuel purposes there seemed to be no good reason why the lighting rate should be above the rate charged for fuel gas, the latter rate being lower than the rate for gas-lighting service.

Volumes have been written upon the subject of equitable rates for gas and electric service, but almost all writers upon the subject devote themselves to the question of dividing the cost of the service equitably between the different classes of consumers—few seem to consider the subject of the relative value of the service. On the contrary, those who actually make and put into force rates for gas and electric service consider most carefully how much the service will bear. The old reproach that public service corporations charge "all the traffic will bear" seems to have caused this phase of the subject to be ignored in public discussions, while it remains an important consideration in the actual making of rates.

It seems to the writer that equitable rates for gas and electricity are based upon two fundamental propositions—(1) that the rates should yield an adequate return upon the investment as a whole, and (2) that the rates should be proportional to what the service will bear. The first relates to the responsibility of the service company and has been generally accepted as a just principle. It needs no discussion. The second proposition relates to the responsibility of the consumer and is the subject of this discussion.

Under competitive conditions it is necessary for the seller of a commodity or service to secure the highest price possible and for the purchaser to secure the commodity or service for the lowest price possible, and under non-competitive but regulated public service this condition is modified only to the extent of the seller being limited to an adequate return upon the capital invested. The purchaser has no more right to demand a rate for service below that which will render an adequate return than the seller has to demand a price which is above that which the purchaser can afford to pay for that particular service. Both purchaser and seller are entitled to equal consideration in deciding upon that neutral meeting ground where business relations will be mutually advantageous.

If gas and electric rates were based only upon the requirement of yielding an adequate return upon the capital invested, without considering the varying value of the service to different classes of consumers, consider the effect upon the consumer and the company.

Large lighting companies sell electric energy for from 1 cent to 15 cents per kw-hr. This energy is produced by the same prime movers and generators, is often delivered over the same wires and is precisely the same in quality for the varying classes of service represented by these widely differing rates. It cannot be shown that the cost of the service to the lighting company varies in anything like this proportion between the different classes of service. Why, then, are such widely varying rates almost universal among electric-service corporations? It is simply because rate makers have considered not only the cost of production and delivery but also "what the service will bear," and the writer holds that this consideration is justifiable and, furthermore, that it is in the interest of the consumers as a whole.

If an electric service company were compelled to sell its whole output at one rate, or if rates were determined strictly upon the cost of the service to the company, it is obvious that the lower rates would have to be materially increased if the total revenue were to be maintained. This increase in the lower rates would exclude a large portion of the electric service which is now in most active competition with other forms of energy, thus narrowing the field of central-station service, while the decrease in the higher rates would render the bills for the small lighting consumer absurdly small for the benefits received. In other words, a small increase in rates for motor service would lose that class of business to the central station, while the higher rates for the small lighting consumer are not burdensome and do not call for a material reduction to a single uniform rate.

The difference in value to the consumer between electric energy used for motors and that used for lamps is more striking than the difference in value of gas used for fuel and gas used for light, but the same principles obtain to justify a higher rate for the higher class gas-lighting service than for the fuel service which is in such active competition with other fuels.

The two most notable examples of charges adjusted to "what the service will bear" are shown in railroad freight rates and in postage rates, and no one can deny that the greatest good to the greatest number results from this adjustment of rates according to the ability

of each class to bear the charge that is imposed on it.

This may seem an academic discussion of long-accepted principles, but recent tendencies in legislation and regulation seem to point toward a leveling of rates regardless of relative benefits to the consumer, and it seems time to admit and strongly maintain that one of the basic principles of rate-making is that the rates should be proportional to what the service will bear.

Utica, N. Y. H. B. SWEET.

Rates for Electric Service

To the Editors of the Electrical World:

SIRS:—In the issue of the *Electrical World* of Dec. 20, 1913, there is a letter by Prof. C. M. Jansky criticising an article by Mr. S. M. Kennedy in your issue of Nov. 22 in regard to rates for electrical energy. In the last paragraph of his letter Professor Jansky states what he believes to be a "fallacy" in the usual method of apportioning costs with relation to rates. And he states: "Underlying this there is another assumption, namely that the *public service* company is a *private* concern." As this is classed by Professor Jansky with another fallacy, the supposition is—and it is borne out by the rest of the paragraph—that this assumption is also a "fallacy." In support of this he quotes Mr. Max Thelen, a member of the California Railroad Commission, who says that "the fundamental relationship existing between the public and its public utilities is that of principal and agent."

The "fallacy" of this character of argument by Professor Jansky and Mr. Thelen is that there is no absolutely exact definition and no definite limit as to what constitutes a "public-service company" or "public utility." The various states have directly or by implication constituted a great many businesses into "public utilities," and these vary greatly between these different states. Those businesses classed as public utilities in some states are not so classed in other states. While it has been generally accepted hitherto that a public utility was a business that served the whole of the public with light, heat, water or transportation, this list of utilities has been greatly increased during the past few years until it has virtually reached its climax in Oklahoma, where a recent decision of the Public Utilities Commission was to the effect that under certain conditions a newspaper was a public utility.

Followed out logically to its conclusion, as shown by the increasing number of businesses brought under the public utilities commissions in the various states, it would seem that there is no kind of business whatever that may not at some time in the near future be made into a public utility.

The mere fact of its being legislatively stated and fixed that a certain character or kind of business is a public utility does not change the principles of the costs and rates or prices of that business. Even when the municipality, the state or the government takes charge of a certain line of business it cannot, without injustice to some, change the basic commercial principles on which a business should be run. It is, therefore, even more unreasonable to require that while a public utility business is owned and operated by private individuals it should be run on principles or under practices that violate absolutely every proper principle or practice of private business.

In reality—although this belief may seem in certain cases to be very much disguised—the general public fully realizes that it obtains a better service from its utilities when they are privately owned than when owned by the community or government, and one of the facts that have been entirely lost sight of by people of Professor Jansky's belief is that such utilities privately owned and operated receive no reward at all for their general greater efficiency over a publicly owned and operated utility, and that the return to the privately owned utility is only an exact and minimum wage. In other words, although a more perfect service to the public is given by a privately owned utility than by one publicly owned, yet there is no greater recompense or incentive given to the privately owned one than is given to the less efficient publicly owned one, or as the laws and commissions express it, all that is due a privately owned utility is "a reasonable return" on its physical investment.

That is neither just nor equitable. The public should divide the extra profit caused by the efforts of those owning or operating the privately owned public utilities with those whose efforts created those extra profits. If through the work and skill and ability of the private owners the costs to the consumer are lessened, a portion of that lessened cost is equitably due those who create it. At the present time in all private businesses *not* "utilities" such extra profit is ungrudgingly allowed by the public to these private concerns, and yet tomorrow, doing exactly the same businesses in exactly the same way, these businesses may be declared to be public utilities and robbed of what is equitably due them.

While it is true that there is no sharp line that can be drawn as to exactly what is the proper and exact price or rate of the product of any public utility, there is the fact that the present existing rates or prices may be lowered by the skill, energy or forethought of the private operators, and my contention is that a portion of this lessened cost—which is in reality an increased profit at the standing rates—is due to those whose efforts lessened these costs.

It is on this basis and on the grounds stated above that such radical principles and practice as those preached by Mr. Thelen and Professory Jansky are neither equitable nor wise. In the present state of municipal governmental affairs no greater calamity could happen to the country than for every municipality to be compelled instantly to take over and operate for itself its various public utilities. Those who are fully acquainted with the general condition of municipal government in the United States at the present time can imagine what would be the results if this should happen. The only thing that prevents such a national calamity at this moment is the private ownership and operation of the public utilities in each community, and to those because of whose ability such evil results as those above referred to are deferred there should be allowed a more adequate reward than a "reasonable return" on the physical property.

To theorize on what should be done if everything and everybody were perfect is one thing; to attempt to force the theory into practice before conditions are in any way fitted for that practice is the greatest of unwisdom. For this to be done as a whole all over the country would be disastrous but might possibly be called "equitable." To insist on this in certain localities or in specific cases is absolutely unjust and unreasonable. There are too many variants in the public utility business at the present moment—and municipal government is one of the greatest of them—for any one to attempt to fit the conditions now existing to any theory which presupposes perfection in men and matter. Mr. Thelen's and Professor Jansky's theories or practices may possibly come to full fruition later on, but to try to enforce either at the present moment would be doing a tremendous injury to that very public whom it is erroneously supposed to benefit.

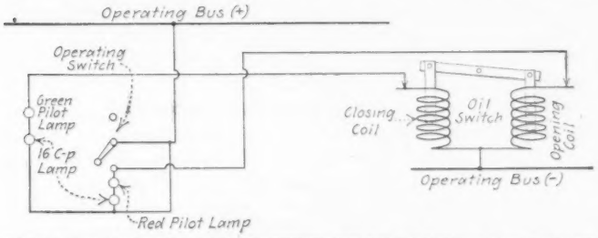
Dallas, Tex. H. S. COOPER.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Prevention of Accidental Operation of Remote-Controlled Circuit-Breakers

The Commonwealth Edison Company of Chicago had trouble at times with remote-controlled switches opening when pilot lamps in the circuits burned out. Upon investigation it was discovered that when a small pilot lamp failed enough energy was available at the lamp to fuse over the base and allow the solenoid to operate the switch. The diagram below shows how these troubles are being prevented in some of the



CARBON LAMPS IN SERIES WITH PILOT LAMPS TO PREVENT SERVICE INTERRUPTIONS

company. An ordinary 16-cp lamp placed in series with the pilot lamp adds resistance to the circuit so that at no time will current enough be available to operate the solenoid switch unless the operating switch is closed. In some instances small fuses are used instead of 16-cp lamps.

Methods of Thawing Water Pipes by Electricity, and Energy Required

Prolonged cold spells which at this season are likely to sweep the country, freezing up water-supply pipes and inconveniencing householders, make timely the topic of thawing such frozen conduits by electricity. Herewith are summarized, therefore, methods of melting electrically ice plugs in buried pipes, either by the use of special transformer apparatus, by adapting standard equipment to pipe-thawing duty or by using only the simplest apparatus.

Electric pipe-thawing practice in general may be divided into two classes—one, most used, in which the heat to melt the ice is generated by passing a large current through the pipe, and the second in which an electrode is immersed in the fluid contained in the pipe, heat being generated as in a water rheostat, by electrolyzing the water near the ice plug. The first method requires large currents and considerable equipment but gives quick results, while the latter avoids the need of special apparatus and can be accomplished in a few hours by a single operator.

Energy for thawing pipes may be obtained in several ways, among them these: By using one or more transformer units to step energy at distribution pressure down to 50 volts or 100 volts; by using energy direct from low-voltage alternating-current or direct-current service wires, or by employing a portable gasoline-engine-driven generator.

Where transformers are used 10-kw or 15-kw units are usually large enough for any ordinary job. If two are required to give a larger current output, their primaries may be connected in series or in parallel, depending on the voltage of the supply source, while the secondaries are connected in multiple. Fuses and demand indicators are usually sufficient to protect the primary circuits. In thawing service transformers may be run, however, at several times their ordinary rating, as they are actually used for only short periods and the heat generated in them is radiated quickly in the cold air. A simple water-barrel rheostat can be employed to regulate the current in the secondary circuit, but it is more generally customary when thawing with transformers to connect the terminals directly to the pipes without any resistance in series except that of the pipe itself. An impedance coil having about twenty turns of wire wound on an old 15-kw transformer core may be employed to replace the water rheostat, current regulation being obtained by changing the number of turns on the core. When thawing service pipes it is generally advisable to disconnect the house piping where it joins the street pipe, in order to prevent the current following any short cut back through some small pipe in the house which may fuse and cause a fire.

A water rheostat made from a water barrel or metal ash can is the only apparatus required when low-voltage service wires are tapped for energy to thaw pipes.

The cost and trouble of collecting and assembling apparatus for thawing only one or two cases of frozen pipes may sometimes be prohibitive. Under such conditions it is sometimes simpler to attach one wire (the grounded side) of a low-voltage circuit to the frozen pipe, which should have been previously filled with a salt solution of water, then threading into the pipe a second weather-proof insulated wire having several narrow rings of insulation removed near the end to allow electrolysis of the solution. The heat generated is concentrated near the ice plug, and as the latter melts the wire can be pushed farther into the pipe. From 3 ft. to 4 ft. of ice per hour can be thawed in this way with a current of 20 amp. This scheme may be modified by inserting in the pipe an electrically heated cartridge unit.

Portable electric thawing outfits may be made by temporarily mounting gasoline-engine-driven generators, transformers or water rheostats on motor trucks during the winter, removing them when no longer required so that the truck may be used for other purposes at other seasons.

Another thawing outfit of an unusual kind employed a 16-to-1 series transformer with its secondary connected in series with a bank of eight 80-watt lamps fed from a 110-volt circuit. The primary winding has large cross-section and is consequently suited to deliver large currents to pipe-thawing circuits.

When drain and waste pipes from boilers are frequently subjected to freezing conditions it has been suggested that a small-diameter iron pipe be permanently fastened along the central axis of the drain. Weather-proof insulated wires can then be fastened to each end of the pipe and when ice clogs the drain the

small-diameter pipe can be heated by electricity until the ice core is melted enough to allow the hot water from the boilers, auxiliary engines, etc., to drain through and do the rest of the thawing.

In the accompanying table are shown results obtained with electric thawing apparatus. In one case, where 2000 services were thawed, the energy used per service varied from 2 kw-hr. to 4 kw-hr. Another company offered a flat rate of $6, $8 and $10 for thawing 0.5-in., 0.75-in. and 1-in. pipe services respectively, and made a time and energy charge on pipes of 1.25 in. diameter or over. Several central-station companies have made a charge of from $10 to $13 per pipe thawed and have made a nice profit thereby, besides the invaluable service rendered customers and fellow-citizens.

TIME AND ENERGY REQUIRED TO THAW WATER PIPES

Pipe Size, In.	Length	Amperes	Voltage	Time Required, Minutes	Kw-hr.	Method
1.00	100 ft.	150	60	20	.....	Pipe resistance
.....	16 ft.	.....	.....	.....	10	Water rheostat
0.75	.....	100	.....	8	42	Pipe resistance
6.00	1 blk.	.....	100	60	75	Pipe resistance
0.75	.....	127.5	110	13	.....	Pipe resistance
0.75	16 ft.	20	.....	270	1.75	Water rheostat
1.00	100 ft.	150	60	25	.....	Pipe resistance
0.50	125 ft.	125	100	10	120	Pipe resistance
0.50	60 ft.	140	130	20	6.1	Pipe resistance
0.50	125 ft.	120	120	30	7.2	Pipe resistance
0.50	120 ft.	120	130	15	3.9	Pipe resistance
0.50	100 ft.	110	120	40	6.6	Pipe resistance
1.25	75 ft.	175	115	30	10.1	Pipe resistance
2.00	100 ft	150	130	30	9.8	Pipe resistance
2.00 + 0.50	30 ft. + 50 ft.	60	130	30	3.9	Pipe resistance
2.00	30 ft.	110	.....	.....	59.4	Pipe resistance

Inspection of Overhead Distribution Systems

Some practical points of interest were made in the report of the committee on standards for inspection of overhead-distribution systems presented on Jan. 16 at the Milwaukee convention of the Wisconsin Electrical Association. The committee says that the objects to be gained by systematic inspection are (a) reduction in hazard to employees and the public generally and (b) the improvement of service rendered to customers. Ideal inspection can only be made with the aid of competent inspectors, and the scarcity of such men constitutes the principal difficulty in securing the desired results. Space provided on the poles and between the wires carried on the poles or cross-arms must be sufficient so that the linemen can keep clear of grounded wires or live wires while working on other wires. Appliances which men are required to reach more or less frequently, such as cut-outs, fuse blocks, disconnecting switches, lightning arresters, etc., should be so placed and arranged that a man standing on pole steps or on his spurs may reach them without coming in contact with other equipment, especially ground wires cleated to the poles or grounded guys.

Inspection means the reporting of all cases of unduly slack wires, decayed or burned poles, cross-arms or pins, as well as wires in contact with, or in dangerous proximity to, other wires, trees or buildings. The accident hazard may be reduced if attention is given to the proper guying of pole lines and the equipment of guy wires with strain insulators. Where guy rods enter the ground they should be protected by wooden guards or boxes painted white.

All lines should be inspected at a certain frequency. This frequency will vary with the character of the construction, the proximity of trees and other structures, the voltage of the line and the relative importance of the different lines. The committee gave the following schedule to be used in determining the minimum frequency of inspection: Lines carrying 7500 volts or over, every three months; lines carrying 1000 to 7500 volts, every six months; lines carrying less than 1000 volts, every year. Some form of regular orders and reports should be adopted by the inspectors. Orders to inspectors should be definite and might read as follows:

"Inspect feeder No. —, covering distance between ——— Street and ——— Street, and report all defects found to exist in connection with this feeder and all other lines supported upon the same poles. Your inspection shall include the inspection of all primary mains and branches connected to this feeder. You will report daily the portions of the feeder or its branches covered by your inspection that day, and report on forms provided all defects discovered. Should you discover a dangerous condition which you cannot temporarily correct, you will immediately communicate with the office and report such dangerous condition, and remain at the point of danger until help arrives or you are otherwise relieved."

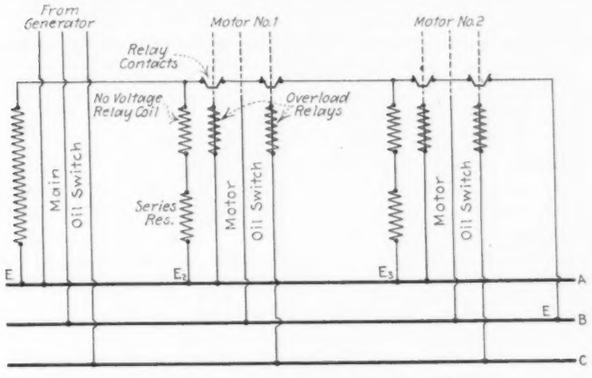
The report forms should show a diagram of a pole with cross-arms and pins and give a printed list of defects to be looked for, so that the inspector may check off readily the items which are not found and indicate otherwise—as, for instance, by a cross mark—the locations of defects. The back of the report form should be used for written description of conditions which cannot be indicated on the diagrams, as, for instance, corroded guys and bad clearances. The committee gave a list of possible defects to be printed on the report forms. These require an examination of poles, cross-arms, cross-arm braces, pins, insulators, tie wires, lightning arresters, potheads and cables, disconnecting switches, fuse blocks, transformers, wires, brackets, street-lighting fixtures, service connections, railway attachments and foreign attachments. The committee did not recommend the making of voltage tests by inspectors. The report was presented by Mr. S. B. Way, vice-president of the Milwaukee Electric Railway & Light Company, chairman, the other members of the committee being Mr. C. R. Phenicie, of Green Bay, and Mr. Peter Valier, of La Crosse. The committee was continued.

Electric Interlocking of Motor Operation

The wiring scheme shown herewith permits the interlocking of any number of electric motors which are intended to be operated simultaneously, the arrangement being such that if one motor oil switch in the system opens all the rest will automatically open likewise. This feature of motor control is provided by reconnecting in the manner shown the overload and no-voltage relays which are regularly furnished with oil switches. *A*, *B* and *C* represent the three legs of a three-phase motor-circuit. Across one pair of these legs is connected a series circuit consisting of all the relay contactors, a series resistance and the no-voltage coil of the main feeder switch. The no-voltage coils on the motor oil switches are also connected in series with definite resistances as shown, while the overload relay coils are connected in the usual manner.

Any relay contactor upon opening will thus trip the no-voltage relays of the other motors either directly or indirectly by first tripping the main oil switch. The scheme described is in use in the Commercial Milling Company's flour mill at Detroit, Mich., where the satisfactory production of flour depends on the simultaneous

operation of all the machines in the system. The resistances shown in the series with each no-voltage relay coil were inserted in the case mentioned since these coils were not designed to operate on 440 volts, the difference of potential between the feeder legs. If the scheme shown is applied to a system containing several motors, it would be advisable to connect E, E_1, E_2, etc., to a separate operating bus energized by a small step-down transformer connected across one phase. If this were done no energy would be wasted in resistors, and the contactors which are exposed on the oil-switch panels would not be carrying a fatal voltage.



SCHEME FOR INTERLOCKING MOTORS

Motor-Driven Blower Keeps Station Exciter Cool

Unfortunately the generating station of an electric-service company in the Middle West is situated in a small valley where a breeze on hot summer days is a rare thing. Consequently the temperature in the station oftentimes reaches a degree not foreseen by the designer of the electrical equipment. An overloaded exciter is the principal sufferer from these conditions, and when a hot wave sweeps the country the machine becomes overheated to the point of smoking. At such times a small motor-driven forge blower is placed on a box near the exciter and its blast directed at the heated windings. With this additional ventilation the exciter has been induced to "pull over" the peaks without noticeable damage.

Use of Twenty-five-Cycle Transformers on Sixty-Cycle Circuits

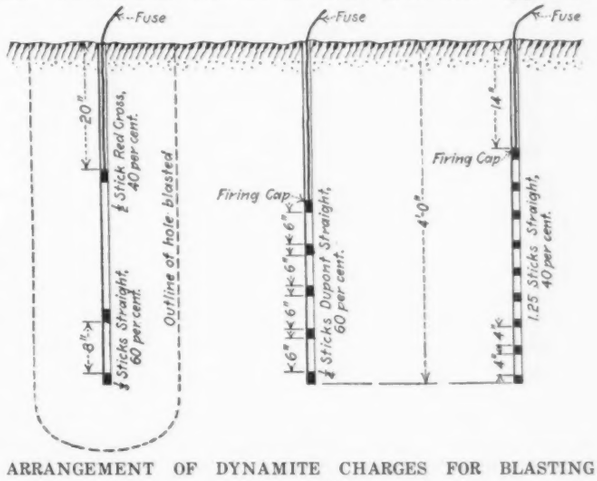
We have a large number of twenty-five-cycle transformers which were formerly used on a 6600-volt circuit. Will it be possible to use these same transformers on a 60-cycle, 6600-volt circuit without changing their construction? D. A. H.

The output of a transformer can always be increased without sacrificing the efficiency if operated at a higher frequency than that for which it was designed. This is true because an increase in frequency (provided other things remain the same) will not affect the eddy-current loss and will reduce the hysteresis loss, thereby permitting a larger copper loss at the same efficiency. Eddy-current loss in a given transformer is proportional to the square of both the frequency and the maximum flux density, but the latter is directly proportional to the potential impressed across the transformer, and inversely proportional to the frequency. It therefore follows that the eddy-current loss is directly proportional to the square of the impressed voltage and independent of the frequency. Hysteresis loss, on the other hand, is proportional to the frequency and the 1.6 power of the maximum flux density in the core. Combining this relation with the proportionality of the flux density previously given, it follows that the hysteresis loss is directly proportional to the 1.6 power of the voltage and inversely proportional to the 0.6 power of the frequency. By increasing the frequency from twenty-five to sixty cycles the hysteresis loss will be decreased by about 15 per cent.

Digging Post Holes with Dynamite

Please advise me concerning methods of digging pole holes with dynamite or giant powder, giving information on the quantity to be used at a charge, arrangement of blast, cost, etc. I have some poles to set in a clay formation which is very difficult to dig by hand. J. F. K.

Assuming that a pole hole 4.5 ft. deep with an average diameter of 16 in. is to be opened, a vertical hole about 2.25 in. in diameter to receive the explosive is first bored to the required depth. A good tool to use is a hollow crown drill having a cutting head 1.75 in. in diameter and a cross-bar 2.25 in. thick. With such a tool one man can drill a 4-ft. hole in five minutes. Good results may also be obtained by driving a 4-ft. punch bar into the earth, meanwhile striking it transversely at intervals to facilitate withdrawal. To prevent earth from falling into the hole after the charge is placed, a cylindrical paper cartridge should be fitted loosely into the drill hole. Before inserting this tube in the hole, however, the dynamite stick should be subdivided and the pieces distributed in the tube by means of a graduated stick, as shown in the accompanying diagrams. Pins may be pushed through the tube into the dynamite to maintain the spacing after the cartridge is inserted in the hole. The exploding cap should be placed in the top stick and the fuse allowed to protrude about 2 in. or 3 in. from the top of the hole, which should be left untamped. If these directions are carried out, according to one of the large powder manufacturers, there will be no general upheaval of earth when the dynamite explodes, and the operator may stand within 2 ft. or 3 ft. of the hole. After the blast very little loose earth is left in the hole, and that remaining may be removed with an ordinary post-hole digger in from five to ten minutes. The cost of opening the earth averages from 25 cents to 30 cents per hole, as compared with 50 cents when dug by hand. The number of holes which a given crew of men can blast in a day is also considerably larger. By properly supervising the work two diggers, one flagman, one hole trimmer and one fuse setter can open from thirty to fifty holes a day.



ARRANGEMENT OF DYNAMITE CHARGES FOR BLASTING POLE HOLES

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Iron Losses of Transformers, Generators and Motors.—J. FISCHER-HINNEN.—A mathematical paper, illustrated by diagrams, on the determination of the iron losses in transformers, generators and motors. The measurement of the iron losses in transformers and induction regulators shows greater losses than would be found from the "loss figure" (verlustziffer) with application of the usual formulas. Under these conditions the exact determination of the "loss figure" has no practical value. It would be more important to organize investigations on a large scale for the purpose of finding formulas which are applicable in practice. For the same frequency the losses increase approximately with the second power of the induction. If the losses are calculated separately, it is recommended to replace the power 1.6 in Steinmetz's formula by 2, simplifying the calculation. The so-called "eddy-current constant" varies within wide limits and depends not only on the "loss figure," but also on the thickness of the sheets. Particularly impressive are the differences between calculated and measured losses in direct-current machines and single-phase alternators. The situation is similar in the case of three-phase motors.—*Elek. u. Masch.* (Vienna), Jan. 4 and 11, 1914.

Commutation of Single-Phase Commutator Motors.—KLAUDIUS SCHENFER.—An account of an experimental investigation of the commutation conditions in single-phase commutator motors with interpoles, built by the Siemens-Schuckert company. Oscillographs are given of the quantities which influence commutation, especially the curves of the magnetic fluxes of the current in the armature, of the additional current in the short-circuited coil and of the commutation voltage. A curve of the variations of current density below the brushes is plotted, and from the form of this curve the author concludes the correctness of the old commutation theory according to which the formation of sparks is due to too high a current density at the brush.—*Elek. u. Masch.* (Vienna), Jan. 11, 1914.

Heating of Pipe-Ventilated Machines.—ALEX. GRAY. An account of an experimental investigation, the principal results of which are as follows: The temperature rise of the windings is proportional to the total copper and iron loss in the machine and is independent of the distribution of this loss. The bearing friction loss has little effect on the internal temperature of the machine. If the quantity of air passing through the machine be increased by increasing the area of the air passages, the air velocity being kept constant, the temperature rise will be reduced, but in most cases an increase in the air velocity will be more effective.—From *Elec. News* (Canada); slightly abbreviated in London *Electrician*, Jan. 16, 1914.

Negative Stray Induction Coefficients.—H. S. HALLO.—With reference to the paper of Rogowski and Simonds on stray fields in alternating-current transformers and commutator motors the author discusses the possibility of negative stray induction coefficients. Whether such coefficients can become negative depends on the definition of stray fields. The author discusses mathematically transformation and stray-field conditions for the general case of the transformer, provided that the winding is distributed in any manner.—*Elek. u. Masch.* (Vienna), Jan. 4, 1914.

Voltage Regulation of Rotary Converters.—A note on a recent British patent (No. 29,338, 1912) of the Siemens Dynamo Works and J. C. Wilson. The exciter shunt-field winding is in series with a resistance controlled by an automatic regulator with its coils connected on the direct-current side of the set.—London *Elec. Eng.*, Jan. 15, 1914.

Lamps and Lighting

Incandescent Lamps.—A note on a recent British patent (No. 2901, 1913) of the British Thomson-Houston Company and the General Electric Company of this country. To prevent blackening of incandescent lamps, cryolite, a double fluoride of sodium and aluminum, is ground to a powder, made into a paste and applied to a part of the lamp interior, where a temperature of between 300 deg. and 800 deg. C. is attained during normal burning. The claims cover the use of a double halogeneous salt or compound of aluminum and an alkaline metal or alkaline-earth metal, including a double fluoride of aluminum and an alkaline metal.—London *Elec. Eng'ing*, Jan. 15, 1914.

Moore Tube.—J. BUJES.—An article illustrated by diagrams in which the author shows that the luminous radiation from the Moore tube must be considered as "volume lighting" instead of as "surface lighting" as in the case of incandescent lamps. The usual method of rating the candle-power of incandescent lamps by their mean horizontal candle-power is not applicable to Moore tubes. For this reason the comparison of the specific consumption of both sources of light on the basis of their mean horizontal candle-powers must lead to wrong results. To get figures of practical value one has to compare the consumption of watts required to produce the same mean illumination of the floor by the two types of lamps under conditions otherwise the same. This comparison is made for a square room illuminated either by Moore or by vertically suspended incandescent lamps. The author finds that the Moore tube consumes less energy and concludes that vertically suspended incandescent lamps without acessories have a poor efficiency. He thinks that for this reason there is an advantage in the use of the incandescent lamps with horizontal filaments which are now on the market.—*Elek. Zeit.*, Jan. 15, 1914.

Generation, Transmission and Distribution

Mechanical Refrigeration.—H. J. MACINTIRE.—The first of a series of articles on the physico-chemical principles on which mechanical refrigeration is based. In the present instalment the author discusses the choice of refrigeration with reference to cost and chemical and physical properties.—*Metall. and Chem. Eng.*, Feb., 1914.

Electricity in French Coal Mines.—J. MATHIVET.—A detailed illustrated description of the use of electricity in the installations of the Compagnie des Mines d'Anzin. There are nine power stations with ratings varying between 500 kw and 6000 kw. The aggregate

rating of the nine stations is 13,250 kw. Methods of interconnection between different stations and methods of wiring and distribution are described and illustrated in diagrams.—*La Revue Elec.*, Jan. 16, 1914.

French Transmission System.—A. SCHOEN AND M. CHARLET.—The conclusion of the illustrated article on the transmission and distribution system of the Compagnie Electrique de Franche-Comté, supplying the Jura district from Besançon to Auxonne. There are four power stations with an aggregate capacity of 1500 hp in water-power and 450-hp steam equipment.—*La Lumière Elec.*, Jan. 3, 1914.

Hydroelectric Stations of France.—Statistical tables giving notes on equipment, etc., of 113 new public water-power stations in different districts in France. While there were only seven such stations in 1880 and 1174 in 1909, there are now 1287.—*La Revue Elec.*, Jan. 16, 1914.

Electricity in the Pyrénées.—A review of the development of hydroelectric industries in the Pyrénées mountains.—*La Lumière Elec.*, Dec. 6, 1913, and Jan. 10, 1914.

Traction

Electrification of Swiss Railways.—J. REYVAL.—An account of the work of the Swiss commission which has investigated the prospects of electrification of Swiss railways with a view to determining that system which would be most satisfactory from an engineering and economic standpoint. Its conclusion is in favor of the single-phase system.—*La Lumière Elec.*, Jan. 10, 1914.

Installations, Systems and Appliances

The "Extralight" Flat-Rate Controller.—H. STAFFORD HATFIELD.—Flat-rate systems using a device to limit the power supplied to a consumer to a certain predetermined amount prove inconvenient when the consumer occasionally wants to exceed his normal limit for an evening. The author describes a cheap and reliable limiter which may be put out of action by the consumer as often as he wishes, up to a certain number of times agreed upon. After some hours the controller automatically resumes its function. The number of times agreed upon is limited adjustably and cannot be exceeded until the apparatus has been reset by a representative of the company. A dial shows the consumer at any time how many free evenings remain to him. In Fig. 1 is shown the working of the arrangement in normal conditions. *A* is a glass tube, with two sealed-in platinum connections *E* and *F*. It contains mercury

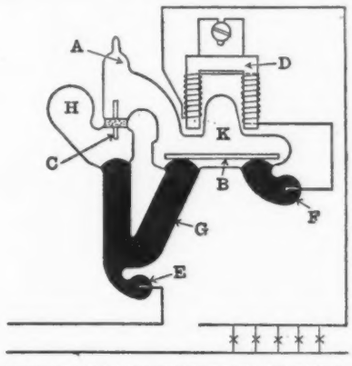
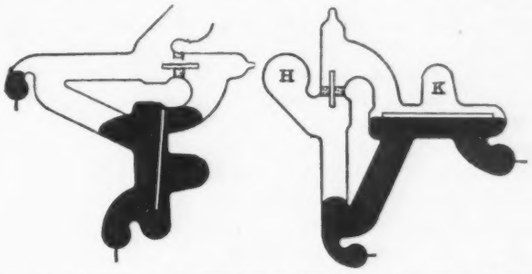


FIG. 1—WORKING ARRANGEMENT FLAT-RATE CONTROLLER

(shaded black) and an iron rod *B* which connects the two mercury surfaces and thus permits the current to flow through the winding of the electromagnet *D* into the consumer's premises. The tube is filled with an indifferent gas. When the current rises above a certain limit, depending upon the distance of the poles of the magnet *D* from the glass tube, the iron rod *B* is attracted, and the circuit is interrupted but is immediately completed again by the falling of the rod so that a rapid blinking of the lamp occurs. At *C* the tube is closed by a plug of dense, porous material. When the tube is turned up into the position shown in Fig. 2 and then turned back as Fig. 3, the mercury takes up a different position, flooding the space *K* and placing the



FIGS. 2 AND 3—DIFFERENT POSITIONS TO PUT LIMITER OUT OF ACTION

gas in *H* under compression. The result of this is to put the limiter out of action, since the contacts are short-circuited and the attraction of the iron rod no longer serves to interrupt the current. At the same time the gas in *H* begins to diffuse slowly through the porous plug back into the other part of the tube, the level of the tube sinking in *K* and rising in *H* to correspond. In this way the former state of affairs is restored after the lapse of a time depending on the resistance to the passage of gas through the porous material, and easily determined in the manufacture of the instrument. This time is, furthermore, extremely constant, being almost independent of temperature. The device, however, does not require great accuracy, since it is merely intended that the light should be free a whole evening. The bulb *H* serves the following purpose: When the limiter acts with the mercury in the normal position heat is developed in the space *K* and expands the gas, which drives the mercury quickly down beyond the reach of the iron rod and breaks the circuit altogether. The bulb *H* allows the necessary gas space for this to occur. The consumer must thus at once switch off the extra demand so that misuse of the apparatus is prevented.—London *Electrician*, Jan. 9, 1914.

Swiss Central-Station Statistics.—An account of the latest statistics of the central stations of Switzerland based on the replies received on inquiry blanks sent out to the plants themselves. The replies seem to have been very incomplete so that the rating figures for 1911 are even less than those recorded for 1910. For this reason no further abstract of the figures is here given. —*Elek. Zeit.*, Jan. 15, 1914.

Wires, Wiring and Conduits

Wiring.—DETHIOLLAZ.—An illustrated article on the methods of fixing conductors to insulators.—*La Lumière Elec.*, Jan. 10, 1914.

Electrophysics and Magnetism

Kelvin Effect.—J. SPIELREIN.—A mathematical paper on the absorption of electromagnetic waves by a cylindrical conductor (Kelvin effect). The author gives the theory in a form applicable for numerical applications and develops a new method of integration which is simpler than that which makes use of Bessel functions.—*La Lumière Elec.*, Jan. 3, 1914.

Electrochemistry and Batteries

Gas Battery.—KARL SIEGEL.—A translation in abstract of the author's German paper recently noticed in the *Digest* on a new gas battery of relatively high output, the special feature of which is the use of electrodes in the form of platinized lumps of carbon, about 3 mm

(0.118 in.) in diameter, in flat earthenware cells, with carbon plates for making the electric connections.—London *Electrician*, Jan. 16, 1914.

Electric Iron Smelting.—JOH. HARDEN.—An analysis of the reasons which have led to comparatively unfavorable results in the trials of electric iron smelting at Hardanger in Norway.—*Metall. and Chem. Eng'ing*, February, 1914.

Refractory Material.—A note on a recent British patent (No. 29,389, 1912) of the British Thomson-Houston Company and the General Electric Company of this country. Silica, carbon and an aluminum silicate with or without manganese oxide are heated in a "smothered-arc" furnace until reduction takes place. A sublimate is formed and condensed in a housing round the furnace. The product will stand compression without much loss of its heat-insulating properties. The proportions of the constituents used are approximately 4 : 2 : 4 : 1.—London *Elec. Eng'ing*, Jan. 15, 1914.

Units, Measurements and Instruments

Electro-Analysis.—D. F. CALHANE AND T. C. WHEATON.—An article on the successful substitution of brass gauze as a cathode in place of platinum in several cases of electrolytic analysis.—*Metall. and Chem. Eng.*, Feb., 1914.

Notation.—The editors of the *Elektrotechnische Zeitschrift* announce that they have adopted the following notation for all articles in that journal, in agreement with the German Association of Electrical Engineers and the Berlin Electrical Society: Length l, mass m, time t, radius r, diameter d, wave-length λ, volume V, angles and arcs α, β, phase difference φ, velocity v, acceleration of gravity g, angular speed ω, number of revolutions n, efficiency η, pressure (force per surface) p, modulus of elasticity E, absolute temperature T, the temperature in degrees measured from the melting point of ice t (when temperature and time occur both in one and the same formula, the temperature is designated by ϑ and the time by t), quantity of heat Q, specific heat c, specific heat at constant pressure c_p, specific heat at constant volume c_v, thermal coefficient of elongation α, intensity of magnetization $\mathfrak{J}$, magnetic field intensity $\mathfrak{H}$, magnetic flux density or induction $\mathfrak{B}$, magnetic permeability μ, magnetic susceptibility $\varkappa$, electromotive force E, quantity of electricity Q, coefficient of self-induction L, electric capacity C, electric current I, electric resistance R. All these symbols are to be used in formulas. The unit of power (mechanical as well as electrical) is the kilowatt, but to prevent misunderstandings, if, for instance, the power of a turbine driving a dynamo is given, it should be said that the power on the turbine shaft is 2500 kw. Notations of units are as follows: For length, *m* (meter), *km, dm, cm, mm*, $\mu = 0.001$ *mm;* for surface, *a, ha,* m^2, km^2, dcm^2, cm^2 mm^2; for volume, *l* (liter), *hl, dl, cl, ml,* km^3, m^3, dcm^3, cm^3, mm^3; for the mass, *t, kg, g, dg, cg, mg.* Of electric units only *S* has so far been adopted for the siemens, the unit of conductance. These symbols of units are to be used only in connection with numerical figures, but never in formulas; for instance, it is correct to write that the length is 500 *m*, but $E_1 = 4.44\ \nu N_1 \Phi_1 \times 10^{-8}$ volt. The same issue contains a summary by K. Strecker of the different notations and units which have been adopted by the International Electrical Commission, the German Association of Electrical Engineers and other societies with reference to other notations and units proposed and likely to be adopted.—*Elek. Zeit.*, Jan. 1, 1914.

Silver Voltameter.—E. B. ROSA, G. W. VINAL AND A. S. MCDANIEL.—The third paper by the authors on the subject, giving an account of their second series of quantitative experiments and the preparation and testing of silver nitrate. Using the small porous-cup voltameter the emf value, 1.01827_5 volts, is found for the Weston normal cell at 20 deg. C. The difference between the values obtained with the large porous-cup voltameter and the smaller sizes is due to impurities present in the electrolyte, which may be partially removed by electrolysis. This phenomenon is called the "volume effect." The temperature coefficient of the voltameter appears to be zero if the electrolyte is pure. Deposits on gold and platinum cathodes are in agreement. For testing the purity of silver nitrate special methods have been devised. Estimates of the acidity may be made to within one part in 1,000,000, using iodisine as an indicator. For testing the solutions for reducing agents and colloidal silver $N/1000$ potassium permanganate has been successfully used. Methods of preparing silver nitrate of a satisfactory purity have been found. These differ considerably from previous methods owing to the conditions demanded by the voltameter work. The fusion of silver nitrate is discussed at length with particular reference to the decomposition of the salt after all of the acid has been expelled.—*Bulletin* Bureau of Standards, Vol. IX, No. 4, Dec. 15, 1913.

Moving-Coil Galvanometer.—At the recent exhibition of the British Physical Society a new moving-coil galvanometer devised by André Onwood was shown. Its

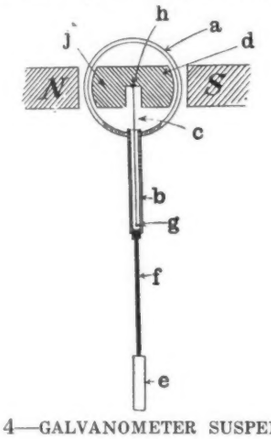


FIG. 4—GALVANOMETER SUSPENSION

feature consists in an entirely new type of suspension which results in an increased sensibility and stands exceptionally rough handling without injury. The instrument requires no leveling. The suspension is illustrated in Fig. 4. A small tube *b* is attached to the bottom of the moving coil *a*, and this is extended downward by a small rod *f*, to the end of which is attached a balance weight *e*. The phosphor-bronze suspension wire *c* is attached to a center pin *g* at the bottom end of the tube and to a tiny spiral spring suspended at the center of the iron core *d*. This spring is not shown in the illustration. As the coil is suspended from its center it always hangs vertically, and consequently a very small air-gap can be used. Such a small air-gap has hitherto been possible only with a pivoted coil, with the attendant disadvantages of the friction of the pivot. With this instrument there is no friction, and therefore its deflections are very uniform. The spring in the suspension takes up any small shocks to which the instrument is subjected, and in the case of a severe jar the coil rests against the sides of the air-gap, and no damage is done. If the instrument is not set up horizontally, any error introduced by the scale not being parallel to the swing of the pointer (which must always be horizontal, as it is connected to the coil) is counterbalanced by the fact that the field cuts the coil at a small angle to the horizontal and consequently exerts

a smaller torque.—London *Electrician*, Jan. 9, 1914.

Localizing Cable Faults.—The Land und Seekabelwerke A. G., in a long communication illustrated by diagrams, discusses the recommendation recently made by various authors that for the localization of cable faults the voltage-drop method is more suitable than the bridge-zero method. The conclusion is reached that the bridge-zero method is more exact and more convenient. On the other hand, in another communication Rich. Randhagen reaches the opposite conclusion, that the voltage-drop method is superior.—*Elek. Zeit.*, Jan. 8, 1914.

Measuring the High-Temperature Resistivity of Refractories.—E. F. NORTHRUP.—An illustrated description of a new and very convenient method for determining the electric resistivity of refractories at high temperatures, together with the results obtained by this method for alundum.—*Metall. and Chem. Eng.*, February, 1914.

Electrostatic Voltmeter.—An illustrated description of the Szilard electrostatic voltmeter (Fig. 5), which has only a single quadrant consisting of a pair of sectors *S*, which are carefully insulated. The bridge *PP* holds the axle *X* between two rubies. This axle sup-

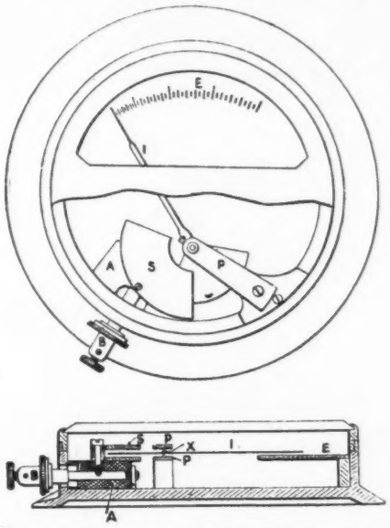


FIG. 5—DIAGRAM OF ELECTROSTATIC VOLTMETER

ports in its central point a needle *I* one wing of which has the same circular form as the needle of Lord Kelvin, while the other end is straight and pointed. A spiral spring mounted on the axle *X* gives a directing force to the needle. The two sectors of the quadrant are made of magnetized steel and constitute the damping system. No other part of the apparatus consists of magnetic metal. The insulating material *A* is completely inclosed and protected. The terminal *B* is connected to the sectors *S*. The apparatus is intended as a substitute for electroscopes in all their applications and for electrometers in many cases.—*La Revue Elec.*, Jan. 2, 1914.

Megohm-Meter.—An illustrated description of the megohm-meter of Chauvin and Arnoux which permits the measurement of high resistances up to 100,000 megohms at a potential of 300 volts.—*La Revue Elec.*, Jan. 2, 1914.

Telegraphy, Telephony and Signals

Loading of Telephone Lines.—J. G. HILL.—A long abstract of a mathematical paper read before the (British) Institution of Post Office Electrical Engineers. The author endeavors to give the theory of loading with induction coils in as simple a form as possible.—London *Electrician*, Jan. 16, 1914.

Book Reviews

FACTORY LIGHTING. By Clarence E. Clewell. New York: McGraw-Hill Book Company, Inc. 161 pages, 100 illus. Price, $2.

A very practical treatise on industrial lighting in factories from the standpoint of the designing illuminating engineer, based on experience in factory illumination. The book assumes a certain familiarity on the part of the reader with the elementary principles of light and illumination. It enters at once into practical applications of those principles. Numerous pictures are given illustrating the installations described. The ten chapters of the book relate to the following subjects: General items; illumination design; lighting; installation work; lighting maintenance; office lighting; drafting-room lighting; factory lighting; power-house lighting; iron and steel mill lighting, and machine tool lighting. The book will commend itself not only to works managers and illuminating engineers but also to central-station salesmen who want the most practical information on good and bad lighting without algebra or details of photometry.

LIGHT, RADIATION AND ILLUMINATION. Translated from the German of Paul Högner by Justus Eck. New York: D. Van Nostrand Company. 88 pages, illus. Price, $2.50.

A handbook in "The Electrician" series, and a good translation into English of Högner's volume. It contains many useful illuminating-engineering tables and diagrams. The sections into which the book is divided relate to the following subjects: Light emission from surfaces; light emission from bodies; light emission from arc lamps; radiation density; unidirectional illumination; calculation methods; street illumination; determination of vertical surface illumination from mean horizontal surface illumination. It would assist the reader of future editions of the book if a short chapter were inserted on units and their magnitudes. Thus the "lux" is largely employed as a unit of illumination throughout the book, apparently with the meaning of a meter-international candle. Nevertheless, it is difficult to find any statement to this effect, and the term "lux" is frequently used by German writers with a different meaning; namely, the meter-hefner.

A PRIMER OF THE INTERNAL-COMBUSTION ENGINE. By H. E. Wimperis. New York: D. Van Nostrand Company. 144 pages, illus. Price, $1.

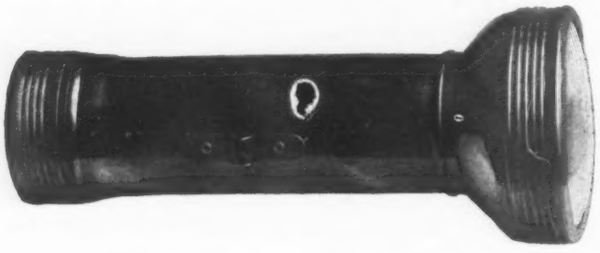
For those who approach a new subject for the first time, an elementary book covering the ground broadly, while laying stress on fundamental principles, is very helpful because the essentials are not lost sight of in a multiplicity of detail or a searching scientific analysis. As an introduction to more advanced works, this primer fulfils its purpose admirably, the matter being well arranged and the language clear and simple. After an introductory chapter giving a brief outline of the historical development of the internal-combustion engine, the theory of heat and the laws governing the behavior of gases and vapors are clearly presented. The ideal engine is then considered, being followed by a description of the various types of practical engine. One chapter is devoted to fuels and gas producers, while details such as methods of ignition, speed-governing and carburetors receive their due share of attention. The last chapter describes the nature of tests as usually made on engines of this type. The value of the book to teachers and students is greatly enhanced by the numerical problems which are given at the close of the several chapters.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Hand Searchlamp

The hand searchlamp illustrated herewith is being put on the market by the Niagara Searchlight Company, Niagara Falls, N. Y. It is known as the army type of lamp. Energy is obtained from a battery of two cells. The battery and the reflector are inclosed

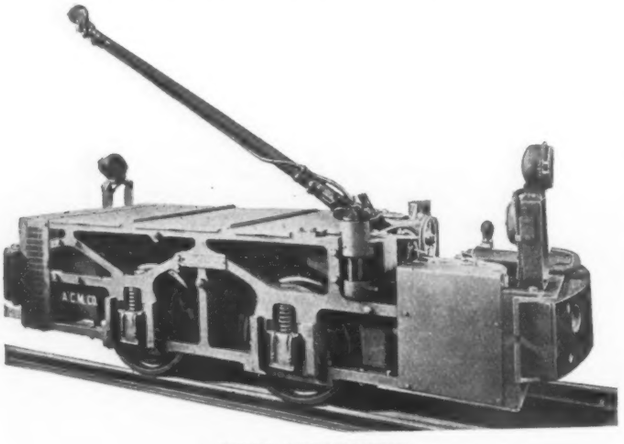


HAND SEARCHLAMP WITH METAL CASE

in a one-piece metal case with a mottled-bronze outside finish. The reflector is made of burnished silver. The cap at the battery end and the lens holder are screwed on to the case. The small tungsten lamp is put in circuit by a slide contact shown in the illustration.

Electric Mine Locomotives

The Anaconda Copper Mining Company, Butte, Mont., recently ordered seventeen 3.5-ton and 4-ton locomotives for underground haulage from the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The locomotives, one of which is illus-



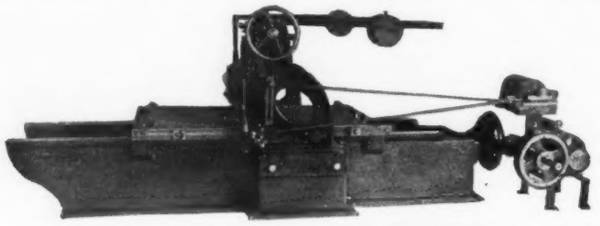
MINE LOCOMOTIVE

trated herewith, are of the open-frame, bar-steel type of construction, and each is equipped with two 11-hp commutating-pole motors.

The Anaconda company and its subsidiaries use a large number of electric mine locomotives. In the past this company has preferred the tractors with standard steel-plate construction, sometimes referred to as the armor-plate type. Recently, however, the open-frame bar-steel locomotives have been experimented with and have been found so satisfactory that the foregoing order resulted.

Electric Drive for Stone Planer

A lithographers' stone planer, manufactured by the Fuchs & Lang Company, New York, and driven by a

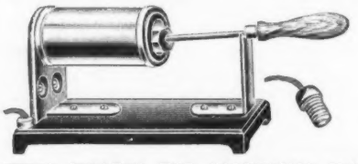


STONE PLANER WITH ELECTRIC DRIVE

Diehl motor of the commutating-pole, reversible type, is shown herewith. The motor is operated by a starting and reversing switch, controlled by a rod attached to the bed of the machine. The motor works approximately one and three-quarter times as fast in the reverse direction when not cutting as in the forward direction when cutting. Power is transmitted from the motor to the planer by a rawhide pinion, a cast-iron gear and a worm gear. A dynamic brake for quick stopping is unnecessary. By means of the motor drive the former double belting from the overhead shaft has been eliminated, together with the noise due to the shifting of the belt at each reversal.

Electric Heater for Soldering Irons

The Current Electric Company, 16 East Kinzie Street, Chicago, has just put on the market an electric heater for soldering irons. With this device the mechanic who has soldering to do uses the same irons which he has been employing, but heats them electrically instead of by means of gas or gasoline. As will be seen from the illustration, the iron is thrust point foremost into the furnace, the heating coil surrounding the tube on which the iron rests. Heaters are made in



ELECTRIC HEATER FOR SOLDERING IRONS

three sizes, namely, 100-watt, 350-watt and 500-watt. The 100-watt furnace is adaptable for jewelers' work and can be operated for a few cents a day. All three types are said to be more economical in operation than gas furnaces of like size. Tests on the medium-sized furnace showed that the interior of the furnace becomes red hot when operated empty in less than five minutes. An iron which fills the aperture can be heated

to the necessary temperature for soldering in about eight minutes with the furnace starting cold. With the furnace heated an iron can be brought to a temperature suitable for soldering in about three minutes. Each unit is mounted on a cast-iron base and is equipped with a strip-steel support for the soldering iron. In case of accident or burn-out the heating element can be readily replaced.

Vertical Charging Rectifier

Herewith is illustrated a rectifier designed for the automatic charging of automobile storage batteries. The apparatus is of the vertical type, use being made of a squirrel-cage alternating-current motor placed beneath the direct-current generator. By this arrangement the commutator, which alone requires any attention, is placed at the top and is therefore easily accessible. The two machines are rigidly joined together in one frame and the rotating parts are assembled on one shaft. Ball bearings are used both at the top and bottom of the shaft, the lower set being a combination thrust and annular bearing for carrying the weight and maintaining the horizontal alignment, while the upper set is an annular bearing for keeping the shaft vertical.

CHARGING APPARATUS

An alternating-current solenoid switch controlling both the alternating-current and direct-current circuits brings the machine up to speed as soon as the main switch is closed by the discharge of the battery into the generator, thus operating the machine as a motor. The alternating-current line is cut off from the motor by this switch while the starting operation is taking place. This switch also provides for automatically restarting the apparatus in case of line interruptions. When the battery is fully charged the switch automatically stops the machine.

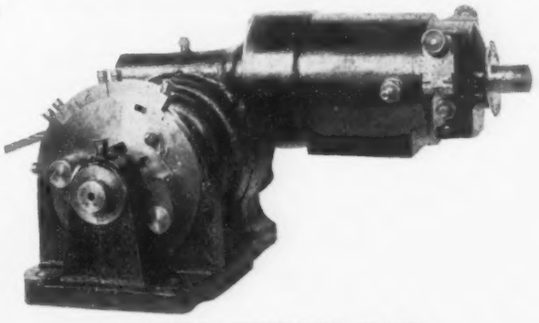
This Wotton rectifier is manufactured by the Electric Products Company, Cleveland, Ohio.

Electric Emergency Brake for Automobiles

An electrical device for operating the emergency brakes on either old or new automobiles without removing the hands from the steering wheel has been developed by the Hartford Suspension Company, Jersey City, N. J. It consists of a small high-speed electric motor connected by an irreversible worm gear to a drum around which winds a cable operating the brake-bands.

This actuating unit measures 8 in. long by 6 in. wide and 4 in. high and is so light that practically no weight is added to the car when the usual emergency brake lever and connections which it replaces are removed. The motor is capable of exerting a 1000-lb. pull on the cable with an input of 30 watts and is designed for pressures of 6, 12 and 24 volts.

This form of electric brake was originally brought out to replace the Westinghouse air equipment for railroad service. The chief merit of the electric brake is its high speed of operation, as it requires only one-fifth second as compared with five seconds for air-brake operation. The device can be made to brake gradually or instantaneously, depending on the length of contact allowed by the automatic controller. The controller lever may be mounted on the steering column and can be moved either forward or backward to apply or release the brakes. A slight forward movement of the lever causes a clicking sound, at the same time allowing the motor to revolve a definite number of times. Further forward movement repeats the operation. To

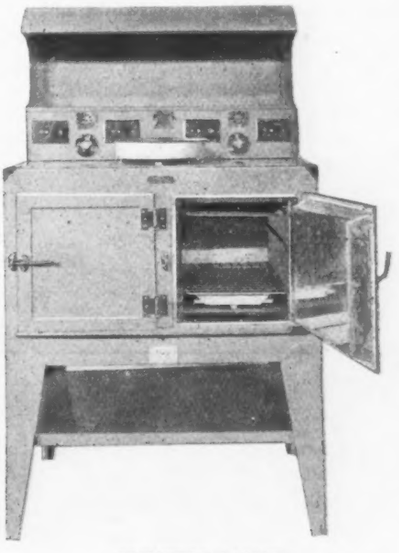


ELECTRIC AUTOMOBILE BRAKE

apply the brakes suddenly the lever should be pushed to the extreme forward position.

Automatic Electric Range

A portable range put on the market by the Olston Electric Stove Company, Los Angeles, Cal., is shown herewith. The range is constructed entirely of sheet metal and aluminum, no castings being used. The ovens are insulated chambers and retain practically all the heat generated. An automatic thermostat, which is adjusted from the outside by a knob and a pointer attached to a dial, controls the heat produced. The thermostat can be set for any predetermined degree of heat and when the desired temperature is reached the thermostat automatically cuts off the energy supply; then as the oven gradually cools the heating unit is



ELECTRIC RANGE

automatically put in circuit again and brings the oven back to the predetermined temperature.

The oven at the left in the illustration is fitted with one heating element in the bottom. This oven is 11.5 in. wide, 11.5 in. high and 16 in. deep. The right oven is fitted with a heating unit in the bottom and one in the top, the latter being used for broiling and toasting. The size of this oven is 11.5 in. by 11.5 in. by 18 in.

The range is equipped with a porcelain broiler pan and four wire grates. The condensation is carried to a drip pan by means of troughs and conductors. The hot plate as shown is a permanent fixture of the range.

Variable Frequency Alternators

Alternating-current generators equipped with pole-changing devices by means of which the periodicity of the machines can be altered without great variations in speed are illustrated in Figs. 1 and 2.

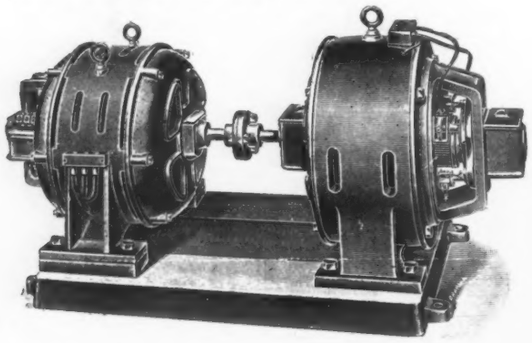


FIG. 1—ALTERNATOR COUPLED TO MOTOR

With alternators wound for forty to 160 cycles and having speeds varying from 800 to 1600 r.p.m. six-pole and twelve-pole windings are used. The field has twelve polar projections which by means of a double-pole switch are arranged to give two north poles and two south poles alternately or a north pole and a south pole alternately, in the former case making six poles and in the latter twelve poles. The stator winding consists of a circuit comprising six main coils and six accessory coils, the latter being used only for the six-pole combination.

By means of a double-pole switch the stator coils can be arranged to give a six-coil, twelve-pole winding. The coils are wound with empty slots in the middle and between them, and when arranged to give six north poles the intermediate spaces form the six south poles, thus obtaining a twelve-pole stator. When connected to give six poles of alternating polarity the spaces between the coils which are wound with the accessory coils are connected in circuit by the switch.

Fig. 1 illustrates an alternator coupled to a motor

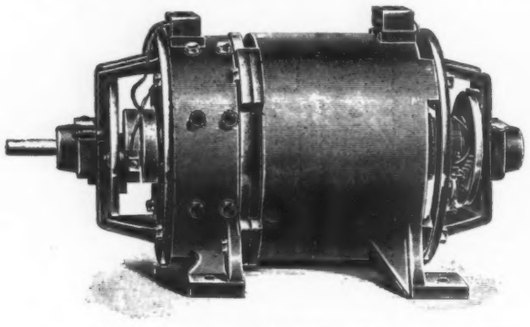


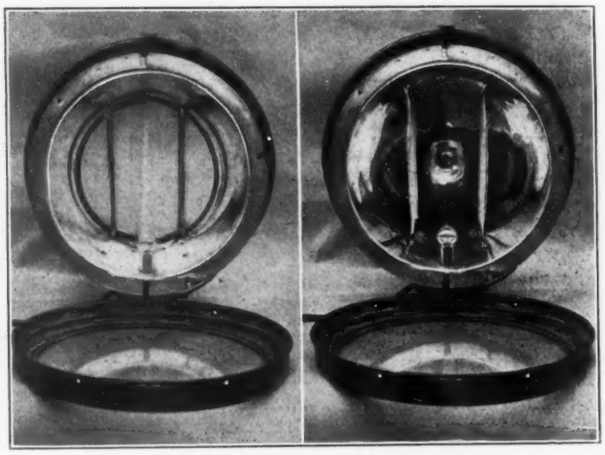
FIG. 2—COMBINED TYPE ALTERNATOR AND MOTOR

and Fig. 2 shows the combined type of alternator and motor. These machines, which are used for testing alternating-current motors for any frequency or voltage and also for wireless telegraphy, medical work, meter testing, etc., are manufactured by the Crypto Electrical Company, 149 Bermondsey Street, London, S. E.

Convertible Automobile Headlamp

The automobile headlamp illustrated herewith has been designed both for use in city streets where glare is undesirable and on country roads where a stronger light is needed. The device consists of two pairs of translucent wings mounted on pivots or bearings fastened in the headlamp reflector. These wings are opened and closed by electromagnets inside the cover of the lamp. When reduced light is desired, the wings are closed by pressing a push-button located on the dashboard or any other convenient part of the car. With the wings closed, no glare is apparent, but the road in front of the car is illuminated with a strong, diffused light. By pushing another button the wings are opened and a concentrated searchlamp beam is available.

This lamp, which is called the Nodaz headlamp, is manufactured by the Ward-Leonard Electric Company,

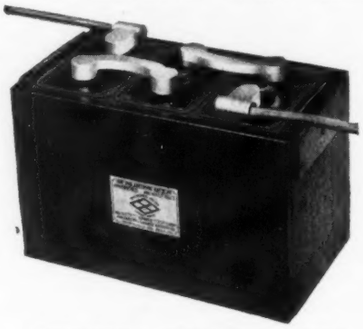


CONVERTIBLE HEADLAMP FOR AUTOMOBILE

Bronxville, N. Y. The apparatus for producing the two distributions of light is designed so that it can be attached to practically any headlamp.

Storage Battery for Electric Starters

The Philadelphia Storage Battery Company, Philadelphia, Pa., has brought out a new type of storage battery for use with automobile electric cranking appa-



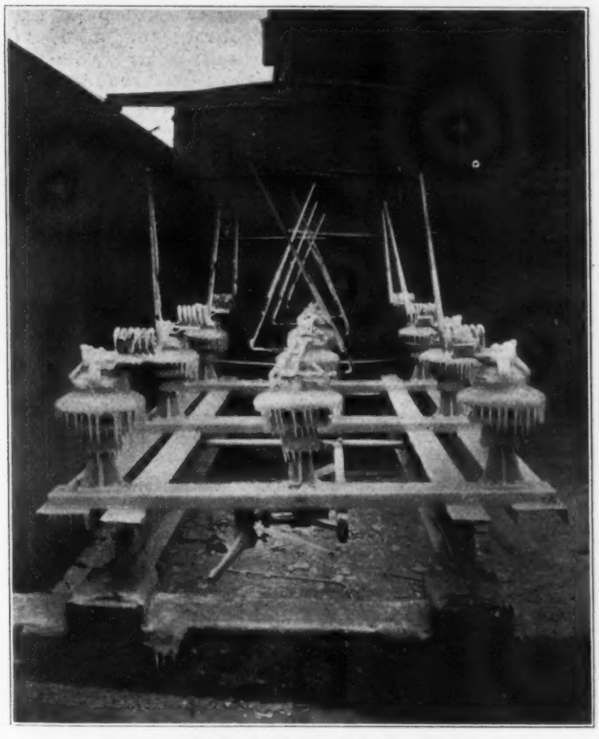
AUTOMOBILE STORAGE BATTERY

ratus. This battery is made in 6-volt, 12-volt, 16-volt, 18-volt and 24-volt sizes, having ratings of 80, 100, 120 and 160 amp-hr. at normal discharge. Diamond-grid plates are used for both positive and negative elements, and each cell is made a separate unit in itself by using outside lead connectors. Wooden separators are employed between the plates and a double cover, and an

air chamber is provided on each battery. Heretofore the starting batteries made by this company had inside connections, and when a weakness developed in one cell it was necessary to remove the entire top of the battery to get at the trouble. Now it is necessary only to cut the lead connectors with a "hot knife" and withdraw the faulty cell. The batteries conform to the standards of the Society of Automobile Engineers and are equipped with drop handles.

Effect of Ice Formation on Pole-Top Switches

The Delta-Star Electric Company, Chicago, Ill., has been conducting tests to determine the effect of ice formations on pole-top high-tension air-break switches. The illustration shows an ice-covered switch used in one of these experiments. The switch was mounted on the factory roof, where plenty of water could be obtained, and a heavy spray was directed over the entire switch for several hours. The ice deposit secured was much heavier than would occur ordinarily during a severe sleet storm; but in spite of the heavy frozen



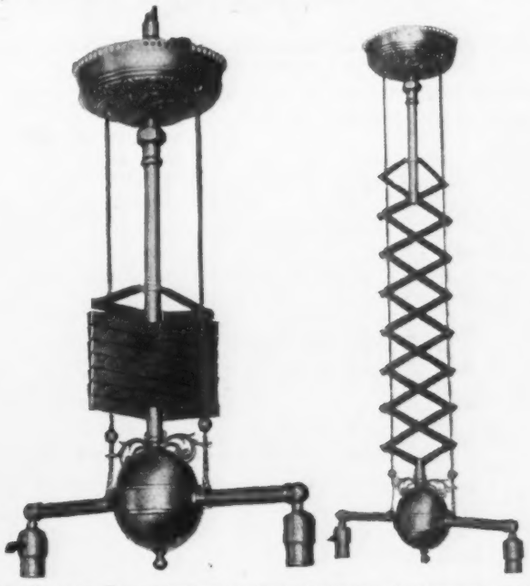
ICE-COVERED POLE-TOP SWITCH

coating the switches were readily opened. The illustration gives an end view of the switch after being opened, the method of mounting, source of water supply, etc., being clearly shown.

Extensible Electric-Lamp Fixtures

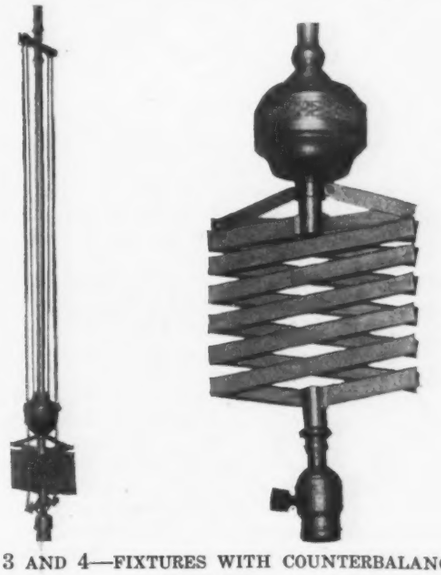
The extensible lighting fixtures illustrated herewith are designed for raising or lowering electric lamps over desks or tables and adjusting them to any position desired. The extensible arm is similar in construction to a pair of lazy-tongs. The device can be attached to a single-lamp, a two-lamp, a three-lamp or a four-lamp chandelier, and the old equipment need not be discarded as the fixture is adaptable to practically any style of chandelier. All wires are hidden behind the bars of the extensible arm. Different methods of counterbalancing distinguish the various types of fixtures, the arms in all cases being of the same design.

In Fig. 1 is shown a fixture having a spring at the top as a counterbalance. Fig. 2 illustrates the same type with arm partly opened or drawn out. In Fig. 3



FIGS. 1 AND 2—FIXTURE WITH SPRING COUNTERBALANCE

is shown a device which, instead of a spring, has a receptacle that slides up and down the tubing shown. This receptacle is equipped with counterbalancing weights the number of which are varied according to the number of lamps used. Fig. 4 shows another style of fixture with weights for counterbalancing. In this type the cross-arm and chains shown in Fig. 3 are not



FIGS. 3 AND 4—FIXTURES WITH COUNTERBALANCING WEIGHTS

used, the extensible arm being fastened directly to the receptacle and supporting the entire weight of the lamp. Such a fixture is suitable for single lamps, and, by doing away with the receptacle, it can also be used as an extensible wall bracket.

These fixtures are being put on the market by Mr. Frederick Garrecht, Idaho City, Idaho.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Electric Drive for Kentucky Steel Plant.—The Louisville (Ky.) Gas & Electric Company reports that Grainger & Company, of that city, who operate a structural-steel plant, have shut down the three steam engines which have been used in driving the machinery in their establishment. The central-station company has received a contract to supply the entire energy requirements of this steel-fabricating concern.

Manufacturer of Electric Washers Optimistic.—The following extract from a letter from J. A. Winger, of the Automatic Electric Washer Company, Newton, Ia., carries a breath of undisguised optimism. He says in part: "We certainly had a splendid business last year, showing the greatest increase in our history, and 1914 is starting out finely. We believe that it is going to surpass anything heretofore achieved. There is a very optimistic feeling expressed by everyone with whom we come in contact."

Operating Company to Push Electric-Vehicle Business.—The United Electric Light & Power Company, of New York, has established an electric-vehicle bureau for the purpose of furthering the sale and use of electric vehicles in New York City. It is the United company's desire to co-operate with the firms distributing vehicles and accessories and with the garages and owners of vehicles. Data on transportation and operation will also be collected. D. F. Tobias has been appointed manager of the new electric-vehicle bureau.

Motor Specialties in Demand.—The Menominee (Mich.) Electric Manufacturing Company, of which L. W. Wood is sales manager, and which makes small electric motors, desk fans, vacuum cleaners and other specialties, reports an especially active demand for washing-machine and electric-piano motors. One interesting feature about the vacuum cleaner made by this concern is that it employs twin exhaust fans. These fans are placed on each side of an air-cooled electric motor, each fan being mounted on the extension of the motor shaft.

Industrial Power Contract at High Load-Factor.—The By-products Coke Corporation, Chicago, has recently signed a contract with the Commonwealth Edison Company by which it is to be supplied with 400 kw continuously throughout the entire twenty-four hours of the day. The change which is being made does not necessitate the purchase of additional equipment, as the same motors which have been operating the coal conveyors and pumps at the coke plant will be connected to the central-station company's circuits. The total load of the By-products Coke Corporation's plant is nearly 1800 hp.

Importer Looks for Growth in Arc-Lamp Business.—The H. M. Hirschberg Company, 39 East Twentieth Street, New York, reports that its business last year was, if anything, ahead of expectations. The sale of both lamps and carbons increased very materially. The outlook for 1914 is in a measure even better, as on the advent of the company's new long-hour flaming-arc lamp, which is now virtually ready for the market, it expects a very great increase of business. The outlook for the carbon trade is also very bright, although the increase of duty on flame carbons is making it a little difficult for the company to compete in some lines.

Storage-Battery Manufacturer Gives Dinner in Chicago.—The Electric Storage Battery Company, of Philadelphia, gave its sixth annual "Exide" dinner on the evening of Jan. 28 at the Midday Club in Chicago. The occasion was simply a get-together meeting for electric-vehicle manufacturers and dealers and the distributors of "Exide" batteries. Herbert Lloyd, president and general manager of the company, presided, and there were no speeches, the entertainment consisting of a vaudeville and cabaret show. There were about 250 guests present, including representatives of the Baker, Rauch & Lang, Chicago Electric, Borland-Grannis, Ohio Electric, Broc, Waverly, Walker, Argo and General Vehicle companies.

Brickyard Adopts Individual-Motor Drive with Central-Station Energy.—The Chicago Brick Company, operating a yard in Riverdale, Ill., with an annual output of about 50,000,000 bricks, is discarding its steam engines for motor drive, with energy to be furnished from the mains of the Commonwealth Edison Company. The motors will range in size from one of 200-hp rating, driving the brick machine, to the 3-hp motors for various auxiliaries. The company has been operating motors totaling 180 hp for some time, supplementing its steam engines, and these motors, together with those being installed, will provide a connected load of about 1000 hp. Steam from the boilers will be used in the future as an atomizing agent for the oil burners under the brick ovens. Tests made by the Commonwealth Edison Company on other brickyards near Chicago show that approximately 13 kw-hr. is consumed in making 1000 bricks.

Electric Signs Find Favor in China.—During the past year the use of electric signs grew rapidly in Hongkong, but was confined to the comparatively simple varieties. Several of the large Chinese department stores and restaurants display electric signs of some size bearing Chinese characters. The use of electric and other signs is strictly limited by the local government, because of the prevalence of severe storms, and in order also to save the landscape from being unduly defaced. On the other hand, the merchants of that city are increasingly active in applying modern methods to their advertising and selling, and the field for small electric signs is correspondingly better. Electrical energy is comparatively cheap, and with the steady expansion of electric lighting service the sign and appliance business should increase. It is thought that some of the large shipping concerns in Hongkong would be good customers for electric signs and general illumination.

Line-Crossing Protection.—As evidence of the increasing attention being paid to the protection of overhead crossings of high-tension lines over telegraph and telephone circuits, it is worthy of note that clamping sets made for this purpose by the Clark Electric & Manufacturing Company, New York, have recently been installed by the Des Moines City Railway Company, the Milwaukee Electric Railways Company, the Aurora, Elgin & Chicago Railways Company, the Consolidated Gas, Electric Light & Power Company, of Baltimore, the South Carolina Light, Power & Railways Company and the Penn Public Service Company. These sets have recently been approved by the American Telephone & Telegraph Company, Chicago.

Commercial Vehicle Standards Issued in Card Form.—From the Automobile Chamber of Commerce, Inc., of 7 West Forty-second Street, New York, a set of cards has been recently issued showing the more important standards for commercial-vehicle manufacture and sale. There are seven cards in the set, and the standards covered are warranty, speed rating, body-weight allowance, overload, caution plate, frame width and length, and demonstration charges. The warranty is a new form, approved Dec. 3, 1913, and supersedes the motor-truck warranty recommended by the N.A.A.M. in 1912. It is a combination of this with the standard passenger-car warranty, adopted in 1910, and covers both commercial and passenger vehicles. An effort is being made to place these standards in the hands of all manufacturers of commercial vehicles and to get them to apply them in their production and

sales departments. The National Automobile Chamber of Commerce, Inc., is the successor of the National Association of Automobile Manufacturers and the Automobile Board of Trade.

No "Free" Service Under New Automobile Selling Plan.—In the Jan. 24 issue of the *Electrical World* note was made of a new selling plan inaugurated by the General Motors Truck Company, of Pontiac, Mich., by which that company hopes to give better satisfaction to its customers, as well as to simplify its own problems. Part of this plan consists of dropping the "free" service scheme used in the past, and it appears that this portion was not sufficiently emphasized in the former note. The company states that it will continue to co-operate to the fullest extent with its customers, to guarantee its trucks fully, to make good anything that is wrong either in material or workmanship, and to give competent instructions regarding operating and care. Another detail of the plan, which has just been brought out, is that it eliminates all trading propositions. The company does not now take in old trucks at any price. By the shortening of credits, elimination of the "free" service and exchange features of the old plan, better engineering in the selection of the car for each special job, and an increase of production, the company expects to reduce the price of its trucks and at the same time do a better business.

Electrical Equipment Ordered from the Westinghouse Company.—The following are among the recent orders for electrical equipment received by the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. The Southern Power Company has ordered one 3000-kva portable substation, consisting of one steel car-switching outfit, three 1000-kva transformers and one 20-hp motor for driving a Sirocco blower. An order has been placed by Fitzpatrick & Hoepfner for one 200-kw, three-wire, compound-wound generator; one 150-kw, three-wire, compound-wound generator; one 100-kw, 1100-r.p.m., three-bearing motor-generator set, comprising a three-wire, compound-wound generator and a 500-volt shunt-wound motor; sixteen direct-current 230-volt motors, ranging from ½ hp to 5 hp, for use with fans and blowers; one commutating turning tool, and one air-cooled portable electric blower to be used on 110-volt direct current. From Leslie B. Grant an order has been received for one 250-kva, 2300-volt, three-phase, sixty-cycle generator, with one 12½-kw exciter; three 85-kva, sixty-cycle transformers and three lightning arresters, 6600-volt, indoor mounting, and switchboard. The above manufacturer will furnish to the Public Service Electric Company a 1000-kva, sixty-cycle, 13,200-6600-volt three-phase, 2600-volt two-phase, duplex transformer. The St. Clair County Gas & Electric Company has bought one 1000-kva frequency-changer set, one 250-kva frequency-changer set, one 50-kw three-bearing motor-generator set, consisting of a 175-hp, 220-volt, three-phase, twenty-five-cycle, 720-r.p.m. induction motor and a 150-kw, 720-r.p.m. compound-wound generator, and three 500-kva, twenty-five-cycle transformers.

Electrically Driven High-Pressure Pumps for Boston, Mass.—In order to provide increased protection against fire for the congested business district of Boston, Mass., it has been decided to erect a high-pressure central pumping station between the Boston Commons and the Public Gardens, from which will radiate a system of special high-pressure watermains, covering that entire district and devoted exclusively to fire service. In case of fire in this district, the alarm will be sounded in the pumping station and the fire houses simultaneously, and within forty-five seconds a pressure of 300 lb. per square inch will be put on the system. This will do away with the necessity for fire-engine service and only the hose lines will have to be brought to the scene of the fire. The Westinghouse Electric & Manufacturing Company has entered into a contract with the city of Boston for all machinery and equipment for this pumping station. The contract calls for six 3000-gal. per minute, six-stage centrifugal pumps; six 700-hp, 6000-volt, sixty-cycle motors; six 13,200-volt, twenty-five-cycle, 800-hp motors, with switchboard and controlling apparatus, traveling cranes and all heavy piping and large valves necessary for the complete equipment of the station. Each pump will be connected by a magnetic coupling on one end to a 700-hp, sixty-cycle motor and on the other end to a 800-hp, twenty-five-cycle motor. Under normal operation each pump is driven by the sixty-cycle motor, drawing energy from the lines of the Edison Electric Illuminating Company of Boston. However, should any mishap occur to the sixty-cycle supply the pump can be instantly operated by its twenty-five-cycle motor, fed from the lines of the Boston Elevated Railroad Company. The motors have wound secondaries, and they do not start until the first point of the automatic controller has been passed. At this point the circuit of the magnetic clutch, between the motor and the pump, is completed. A potential of 13,200 volts was contemplated in the design of the 800-hp motors and is the highest ever used in a motor with a phase-wound secondary.

Mica Mining in India.—Mr. Leo Meirowsky, of the firm of Meirowsky Brothers, 146 Liberty Street, New York, who own and operate their own mica mines in India, with headquarters at Giridih, near Calcutta, has been in this country for the past six or eight weeks and has just left on his return trip. Shortly before his departure for India, Mr. Meirowsky gave some interesting facts to an *Electrical World* representative concerning the mica mining industry in India and the general progress of that country along electrical lines. The mica crystals occur in layers of varying thickness, extending from the surface to an indefinite depth. So far the deposits have not been worked to a depth greater than 300 ft. or 400 ft., and the best grade of mica is generally found at about 150 ft. below the surface. The early native methods of mining were very crude and consisted simply of digging holes in the ground wherever an outcrop of mica was found. The vein was followed as far as a single laborer could do the digging and carry out the mica and refuse. The result was that only the best mica was removed for sale, as the expense for taking out the cheaper grades was too large in comparison to their market value. Another result was that the limits of production possibilities of the mica deposits were soon reached and with the increasing demand for mica the use of more intensive methods was forced. Meirowsky Brothers introduced successful modern methods in 1905 and since that time have by the application of steam power and up-to-date tools achieved a large increase in production. Also the poorer grades of mica can now be extracted with profit. The demand for mica of all grades has increased so rapidly, however, that the supply could not keep pace with it and for the past few years there has been a steady tendency toward increasing prices. Concerning the general progress of the electrical industry in India, Mr. Meirowsky stated that in the larger cities of that country municipal-owned generating stations are supplying electrical energy for lighting service and trolley lines, and to quite a large extent for operating electric fans. Motor drive is not used to any great extent, as far as he knows, although the cotton and jute industries use electrical energy for lighting.

NEW YORK METAL MARKET PRICES

	Jan. 27 Bid	Jan. 27 Asked	Feb. 3 Bid	Feb. 3 Asked
Copper:				
Standard, spot*	....	14.50	....	14.75
	Selling Prices		Selling Prices	
	£ s. d.		£ s. d.	
London, standard, spot*	65 12 6		66 7 6	
Prime Lake	14.75	to 15.00	15.00	to 15.25
Electrolytic	14.50	to 14.60	14.75	to 14.85
Casting	14.30	to 14.40	14.55	to 14.65
Copper wire base	15.75	to	15.87½	to 16.00
Lead	4.10		4.15	
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f.o.b. smelter	7.25		7.25	
Spelter, spot	5.35	to 5.40	5.50	to ....
Tin, spot	39.12½	to 39.37½	40.25	to 40.50
Aluminum:				
Prompt delivery	18.75	to 19.00	18.75	to 19.00
Future	18.50	to 18.75	18.50	to 18.75

***OLD METALS**

Heavy copper and wire	13.62½	13.75
Brass, heavy	8.87½	8.87½
Brass, light	7.87½	7.87½
Lead, heavy	4.05	4.05
Zinc, scrap	4.25	4.25

***COPPER EXPORTS**

Total tons to Feb. 3	1,030

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

Annual Report of the Mount Whitney Power & Electric Company.—The gross earnings of the Mount Whitney Power & Electric Company for the year ended Dec. 31 amounted to $562,852 and the net earnings came to $306,395 during the same period, both of which figures represented material increases over the corresponding figures for 1912. A surplus of $176,495 was realized after deducting all taxes, maintenance and other charges. At the present time there is a good deal of construction work in progress for the company, but it also has a rapidly growing territory, and the new business is expected to more than take care of additional expense for extensions of the service.

Ohio Commission Halts Sale of Utility Property.—The application of the Ohio Service Company for permission to purchase the properties of the New Midland Power & Traction Company was filed recently with the Ohio Public Utilities Commission, but the consent of that body has been withheld, on the ground that the proposed purchase price was in excess of the value of the properties to be acquired. The latter consisted of an electric-lighting and ice-making plant at Cambridge, Ohio, the street-railway lines in that city, and the interurban line between Cambridge and Pleasant City, Ohio, together with franchise rights and other assets. It was proposed by the Ohio Service Company to pay for this combined property $900,000, of which $250,000 was to be in capital stock and the remainder in 6 per cent convertible notes.

Dividend Increase by the Galveston-Houston Electric Company.—On Jan. 22 the directors of the Galveston-Houston Electric Company declared the regular 3½ per cent semi-annual dividend on the preferred stock and the same amount on the common stock, both payable March 16. In the case of the common stock this represents an increase of 1 per cent per annum and places the stock on a 7 per cent basis, which, according to C. M. Clark, secretary of the company, can be conservatively maintained with the present rate of earnings. An issue of $600,000 in three-year 6 per cent bonds falls due on April 1, 1914, and, in order to retire these debts and meet other capital requirements of the current year, there will be offered to holders of both preferred and common stock the right to subscribe pro rata to $1,000,000 of unissued common stock. If paid for in full, this stock will carry the 3½ per cent dividend, payable March 16. As an option this stock may be paid for in two equal instalments.

Georgia Railway & Electric Stock Issue.—Subscription rights to $541,600 of the common stock of the Georgia Railway & Electric Company are being offered to stockholders at $118 a share on the basis of one share of new stock to each twenty shares of stock held. A guaranteed dividend of 8 per cent per annum is paid by the common stock and the Georgia Railway & Power Company also guarantees 5 per cent dividends on the preferred stock. The issue of the above common stock brings the capitalization of the Georgia Railway & Electric Company up to $8,514,600, the full amount at present authorized. The subscriptions have to be made on or before Feb. 15 and a syndicate has made arrangements for purchasing all stock not taken by the stockholders. This company was incorporated in January, 1902, as a consolidation of the Atlanta Railway & Power Company, the Atlanta Rapid Transit Company, the Georgia Electric Light Company and the Atlanta Steam Company. It owns the entire capital stock of the Atlanta Gas Light Company and the Atlanta Northern Railway.

Claims of Bullock Shareholders Adjusted.—An agreement has been reached between O. H. Falk, president of the Allis-Chalmers Manufacturing Company, and C. L. Harrison, A. C. Shinkle and G. D. Eustis, representing the holders of preferred stock of the Bullock Electric Manufacturing Company, as to the plan for taking care of the interests of those stockholders under the reorganized business. The Allis-Chalmers company owns the common stock of the Bullock company, and last January because of financial difficulties of the former the dividends on the preferred stock of the latter, for the last quarter of 1912, were passed. No dividends have since been paid on that stock and part of the agreement consists in payment in cash of all dividends due up to Jan. 1, 1914, amounting to 7½ per cent. The main part of the plan consists in exchanging for $100 par value of preferred stock of the Bullock company $80 par value in 6 per cent bonds of the Allis-Chalmers company, maturing in twenty or twenty-five years, with the option of redemption at any time up to Feb. 1, 1915, with the latter company at $95. There are 243 individual holders of the $1,170,000 preferred stock of the Bullock company, of whom a majority have already approved the above plan. A bond issue of $936,000 will be required to carry out the plan.

Merger of California Electrical Utilities Contemplated.—Plans are on foot for the merging of the Northern California Power Company, Consolidated, and the Oro Electric Corporation by the formation of a holding corporation which will take over the stocks of these two companies in exchange for its own securities. The Oro Electric company was organized in 1911 with a capitalization of $6,500,000 common and $3,500,000 in 6 per cent preferred stock and $10,000,000 bonds, while the Northern California Power Company was incorporated in 1908 and has a capital stock of $10,000,000 with $7,167,200 bonds. The former company controls water-power sites capable of yielding a total of 133,000 hp. The latter operates five hydroelectric plants with a combined output of 57,000 hp. The two concerns which it is planned to merge are working in largely the same territory and have been supplying very similar industrial demands, so the consolidation will probably bring little change in operating policy. In the Jan. 4, 1913, issue of the *Electrical World* note was made of a contract between these two concerns, whereby the Oro company was to obtain 20,000 hp from the other company pending the completion of the former's generating station in Yellow Creek. As noted in the Dec. 13, 1913, issue, the Northern California company supplies energy for extensive electrolytic ore-refining operations in its territory and the Oro company has a large demand for energy for the same purpose.

Central Union Telephone Company Receivership.—In the case of William A. Read and others against the Central Union Telephone Company and others, the receivers have been agreed upon, as previously announced. This is the action brought by minority stockholders on the charge that the American Telephone & Telegraph Company, the controlling owner of the Central Union Telephone Company, has "milked" the company in such a manner that the interests of the plaintiffs were injuriously affected. A long hearing was held in the spring of 1913, and early in November of last year the complainants filed a supplemental bill setting up the financial situation of the Central Union Telephone Company as they contended it then appeared to be from the books of the company. The plaintiffs alleged that on Aug. 31, 1913, the deficit of the company was $3,335,587. In the course of the hearing copies of a number of interesting letters exchanged between F. P. Fish, Theodore N. Vail, B. E. Sunny, L. G. Richardson and others were read. The complainants alleged that these letters contained evidence of fraudulent conduct toward the stockholders of the Central Union Telephone Company. On Dec. 29, 1913, the court entered an order for the appointment of three receivers, the understanding being that the defendants should have the privilege of naming one of the receivers, the complainants another, and the court the third. Under this arrangement it is understood that an agreement has been reached by which the three receivers will consist of Edgar S. Bloom, of St. Louis, vice-president Bell Telephone Company of Missouri, representing the Bell interests; Frank F. Fowle, of New York, a consulting electrical engineer familiar with telephone practice, representing the minority stockholders, and David R. Forgan, president National City Bank of Chicago, representing the court. After the receivers are put in possession of the property and business of the Central Union Telephone Company, the next step will be to bring the cause on for final hearing. On this hearing the court will be asked to decide, first, whether the holding of $5,200,000 of stock (par value) by the American Telephone & Telegraph Company in the Central Union Telephone Company is illegal, and, second, as to the general principles to be followed in the accounting to be had between the American Telephone & Telegraph Company and the Central Union Telephone Company.

Business Notes

The Dyer Flaming Arc Company, Inc., formerly of 225 North Tenth Street, Philadelphia, Pa., has moved to 1714 Sansom Street in the same city.

The Automatic Electric Washer Company, of Newton, Ia., has appointed J. F. Kinder, 526 Yeon Building, Portland, Ore., as its representative in Washington and Oregon.

The Utilities Service Company, of St. Louis, Mo., has announced its removal on Feb. 1 from the La Salle Building to 2082-84 Railway Exchange Building, that city.

The Beck Electrical Construction Company, of 204 Andrus Building, Minneapolis, Minn., has recently secured local territory rights as representative of the American-Ball engine and the Rice & Sargent Corliss engine.

Walton & Beer, formerly at 1166-1184 Bedford Avenue, Brooklyn, N. Y., have arranged for quarters in the Long Acre Building, Broadway and Forty-second Street, New York, where they have their present office.

V. M. Nussbaum & Company, of Fort Wayne, Ind., have bought out the electrical department of the Hanna-Brackenridge Company and is carrying on the business of the latter. The new concern deals in electrical machinery and does electrical contracting and repair work.

Williams, Dunbar & Coleman is the name of the firm recently formed by George Williams, J. T. N. Dunbar and L. G. Coleman to continue the business formerly carried on under the firm name of Williams, McConnell & Coleman at 60 Wall Street, New York City. The concern handles public utility securities and does a general brokerage and investment business.

The Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., has announced the fact that the H. B. Squires Company, of San Francisco, Cal., and Portland, Ore., its Pacific Coast agent, has acquired the additional territory of southern California and established a branch office in the San Fernando Building, Los Angeles. C. W. Yerger, who has been connected with the engineering department of the Cutler-Hammer company for several years, will be in charge of the Los Angeles office.

New Industrial Companies

The Robbins-Putnam Company, of Boston, Mass., has been incorporated by A. M. Robbins, of Cliftondale, Mass., and S. V. Putnam, of Melrose, Mass.

The Economic Power & Product Company, of Philadelphia, Pa., has been incorporated with a capital stock of $10,000,000 by George H. B. Martin, of Camden, N. J.

Bayley & Sons, of Brooklyn, N. Y., have been incorporated by G. W. Bayley, M. S. Bayley and L. S. Bayley, all of Brooklyn. The firm is capitalized at $30,000 and proposes to manufacture and deal in lighting fixtures, etc.

The Industrial Electric Company, of Cleveland, Ohio, has been incorporated with a capital stock of $25,000 to manufacture electrical equipment. The incorporators are Samuel Austin, Wilbert J. Austin, Harold Ferguson, C. W. Kinnison and W. B. Stewart.

The Konary Electric Company, of Cleveland, Ohio, has been incorporated with a capital stock of $10,000 by C. F. Schultz, M. E. Evans, C. S. Bechberger, M. E. Schultz and H. M. Krauss. The company proposes to manufacture and deal in electrical apparatus.

P. W. Brooks & Company, of New York, N. Y., have been chartered with a capital stock of $1,000,000 for the purpose of doing an electrical construction business. The incorporators are E. S. Hodgman, of Bridgeport, Conn.; L. M. Symmes and E. H. Van Wyck, of New York, N. Y.

The Northern Electric Company, Ltd., of Montreal, Que., Can., has been incorporated with a capital stock of $10,000,000 for the purpose of manufacturing and dealing in all kinds of electrical machinery and equipment; also to carry on a general electrical and mechanical engineering business and to acquire and operate telephone, telegraph, light, heat, power and hydraulic plants.

Trade Publications

Wiring Devices.—P. & S. Bulletin 835—Schedule XA—comprises the latest list of some new handy electrical wiring devices manufactured by Pass & Seymour, Inc., Solvay, N. Y.

Pole Reinforcement.—A folder on the Orr reinforcing process, entitled "Making Old Poles Good as New," has been issued by the Pacific States Electric Company, San Francisco, Cal.

Alternators.—Bulletin No. A4143, recently issued by the General Electric Company, is devoted to Form B belt-driven alternators and supersedes the company's previous bulletin on this subject.

Wireless-Telegraph Instruments.—An illustrated catalog of its "Halcun" wireless-telegraph instruments has been published by the Haller-Cunningham Electric Company, 428 Market Street, San Francisco, Cal.

Railway Motor Gears and Pinions.—The General Electric Company has just issued Bulletin No. A-4199, which illustrates and describes its railway motor gears and pinions and contains curves and data concerning them.

Cranes.—Bulletin 401, published recently by the Pawling & Harnischfeger Company, Milwaukee, Wis., refers to its type H crane. It contains a good general description of this apparatus and its various parts, fully illustrated.

Second-Hand Machinery.—The Arthur Jones Electric Company, 223 South Clinton Street, Chicago, Ill., has issued No. 15 of its "Book of Bargains," in which are listed for sale used dynamos, motors, engines and other electrical machinery.

Chain Drives.—The Morse long-service chain drive is the subject of Publication No. 12, recently issued by the Morse Chain Company, Ithaca, N. Y. It contains short, illustrated descriptions of typical Morse silent-chain drives, showing their durability and efficiency for long periods of time.

Portable Meters.—"Westinghouse Portable Meters" (Circular 1104) is the title of an elaborate publication just issued by the Westinghouse Electric & Manufacturing Company describing its complete line of portable instruments. A number of photographs are shown, together with various diagrams.

Lighting Units.—A large variety of semi-indirect lighting units manufactured by the Gleason-Tiebout Glass Company, 93 Commercial Street, Brooklyn, N. Y., are illustrated in a recently issued catalog. Many beautiful designs are shown. Supplements A and B have also been published, in which some artistic bowls are illustrated.

Magneto Generator.—The Holtzer-Cabot Electric Company, Brookline, Mass., has issued a twelve-page booklet on the subject of automobile lighting and battery charging with the Holtzer-Cabot magneto generator, with special reference to its "JS" type. A full description is given accompanied by diagrams showing how the generator is connected.

Conveyor Scales.—The Electric Weighing Company, 180 Thirteenth Avenue, New York, in a recent bulletin refers to its conveyor scales for belt and pan conveyors and duplex scales for pivoted bucket carriers. These are self-registering scales for weighing materials while in motion on conveyors. The pamphlet will interest all who handle material in bulk.

Meters.—Engineering Leaflet No. 16 issued by the Harrison Safety Boiler Works, Philadelphia, Pa., has for its title "A Hot-Water Meter Is Essential to the Economical Management of a Boiler Plant." The subject is comprehensively treated and well illustrated. The publication will be found useful to engineers interested in improving the efficiency of their plants.

Fuses.—In its Catalog No. 22, the Detroit Fuse & Manufacturing Company, Detroit, Mich., illustrates and describes its induction-motor starters, sealable entrance switches, ironclad fused switches, indicating inclosed fuses, automobile fuses, cut-outs, terminals, contact clips and lugs. Numerous diagrams and illustrations serve to give an excellent idea of the construction of these devices.

Personal Mention

Mr. L. A. Ramsay, for some time manager of the new-business department of the Fremont (Neb.) Gas, Electric Light & Power Company, has been transferred to the accounting division.

Mr. W. B. Elliott, for eighteen years works manager at the plant of the C. & C. Electric Company, Garwood, N. J., has resigned. Mr. Elliott is succeeded by Mr. A. H. Mosher, of Westfield, N. J.

Mr. George B. Tripp, vice-president and general manager of the Harrisburg (Pa.) Light & Power Company, was recently elected president of the Harrisburg Chamber of Commerce, the new commercial body of the capital city of Pennsylvania.

Mr. A. J. Marshall, for some time identified with the lighting world as a consulting illuminating engineer and more recently connected with the General Motors Truck Company in the Northern New Jersey territory, has been appointed executive secretary of the Electric Vehicle Association of America.

Mr. W. E. Boileau has resigned as general manager of the Chattanooga (Tenn.) Railway & Light Company. Mr. Boileau was appointed manager of the Chattanooga Electric Company in 1907 and following the consolidation of the company with the corporation operating the street-railway system he was made general manager of the Chattanooga Railway & Light Company.

Mr. William Williams has been appointed commissioner of the Department of Water Supply, Gas and Electricity of New York City. Mr. Williams, who was appointed immigration commissioner by President Roosevelt, was born in New London in 1862 and was graduated from Yale in 1884 and from the Harvard Law School in 1888. He received the degree of M. A. from Yale in 1906 because of his work as immigration commissioner.

Mr. Leonard A. Busby, president of the Chicago City Railway Company, has also been appointed president of the Chicago Surface Lines, which is the name given to the unified organization operating all the surface street railways of Chicago, including those of the Chicago Railways Company as well as those of the Chicago City Railway Company. The unified organization is under the supervision of a board of operation of which Mr. Henry A. Blair is chairman, Mr. Busby being one of the seven members of the board.

Mr. Winthrop More Daniels has been nominated by President Wilson for appointment to the Interstate Commerce Commission. Mr. Daniels is chairman of the Board of Public Utilities Commissioners of New Jersey. He was serving as professor of political economy at Princeton University in 1911 when President Wilson, then Governor, appointed him to the Board of Public Utility Commissioners of New Jersey for a term of six years. He had held the chair of political economy at Princeton since 1892. Mr. Daniels was born in Dayton, Ohio, in 1867.

Mr. Norman McD. Crawford has recently been elected president and general manager of the Reading (Pa.) Transit & Light Company, vice-president and general manager of the Metropolitan Electric Company, vice-president and general manager of the Neversink Mountain Railway and vice-president and general manager of the Oley Valley Railway. Mr. Crawford succeeds Mr. W. S. Barstow in the Reading Transit & Light Company and Mr. W. A. Rigg in the other companies. He was formerly president of the Mahoning & Shenango Railway & Light Company, of Youngstown, Ohio, and was for several years vice-president of the Ohio Electric Railway of Cincinnati, Ohio.

Mr. W. R. Garton has resigned as vice-president and general manager of the Lord Manufacturing Company, of Brooklyn, N. Y., manufacturer of protective and economizing devices. Mr. Garton has been active in the electrical field for many years. He began with the construction and operation of telephone, electric light and railway properties and has given much time to the supply and manufacturing business. Mr. Garton is an associate member of the American Institute of Electrical Engineers and a member of the American Electric Railway Association, the New York Railway Club, the Keystone Electric Railway Club, the New England Street Railway Club and the New York Electric Railway Association.

Mr. King G. Kellogg, who has been chief engineer of the E. E. Brownell Engineering Company for the past four years, has tendered his resignation to take effect March 1, 1914, and will thereafter devote his entire time to consulting work, specializing in matters pertaining to the electrolytic corrosion of underground metallic structures from stray electrical currents. Mr. Kellogg has made electrolysis tests and examinations in more than fifty different cities in this country. He held various positions in the engineering department of the People's Gas, Light & Coke Company, Chicago, where he was employed for sixteen years. He was educated in the Chicago public schools and is an alumnus of the University of Illinois. His office is at 1836 South Fifty-fifth Street, Philadelphia, Pa.

Mr. W. H. Bancroft, president Utah Light & Railway Company, Salt Lake City, Utah, vice-president and general manager of the Oregon Short Line Railroad and vice-president of the Salt Lake Route, has been relieved of his duties as general manager of the Oregon Short Line, at his own request. He will still continue as president of the Utah Light & Railway Company and vice-president of the Salt Lake Route. Mr. Bancroft is seventy-four years of age. He entered the railroad service in 1856 as telegraph operator and ticket clerk for the Michigan Southern Railroad, and has been continually in that service to the present time, rising through the various grades to be the executive head of all of the Harriman interests in the intermountain territory. When the Harriman interests acquired control of the Utah Light & Railway Company in November, 1906, Mr. Bancroft was elected president of the company.

Mr. E. T. Munger, who resigned about a year ago from the office of general superintendent of the Hudson & Manhattan Railroad, New York, N. Y., has accepted the position of general manager of the Cumberland County Power & Light Company, Portland, Maine. This company operates the local railway system in Portland and several interurban lines and electric lighting properties. Previous to his work on the Hudson & Manhattan Railroad, Mr. Munger held a number of responsible engineering positions, such as master mechanic and later superintendent of motive power and equipment of the Metropolitan West Side Elevated Railway, Chicago, and superintendent and later president and general manager of the Havana (Ill.) Telephone Company. He was graduated from the University of Wisconsin in 1892. On Jan. 17, 1914, a farewell luncheon was tendered to him at the Railroad Club by the Deportation Club of New York. Between thirty and forty of Mr. Munger's most intimate friends were present and wished him all success in his new venture. Mr. W. C. Fisk, of Harvey Fisk & Sons, New York, was toastmaster, and before the conclusion of the luncheon a handsome silver loving cup was presented to Mr. Munger.

Mr. Thomas H. Yawger, one of the best-known operating men in the business, has just rounded out twenty-five years of continuous service with the Rochester (N. Y.) Railway & Light Company. Mr. Yawger began service with the Edison Illuminating Company of Rochester on Dec. 1, 1888, as a helper, when he served as the medium of communication between the foreman and his men or ran errands to other departments. Whatever spare time he had was used in reading the available literature dealing with electricity, and at the end of his first three years Mr. Yawger entered the Mechanics' Institute and began a course of mechanical engineering. In 1890 Mr. Yawger was made foreman of station No. 2, and in 1901, following the consolidation of the gas and electric properties, he was appointed assistant superintendent of electrical distribution. In 1904, when Mr. J. T. Hutchings was made superintendent, Mr. Yawger continued as as-

THOMAS H. YAWGER

sistant superintendent, and when two years later Mr. Hutchings succeeded Mr. R. M. Searle, present vice-president, as general manager, Mr. Yawger was made superintendent. Possessed of a quiet and unassuming disposition, Mr. Yawger is very popular not only with the employees of the Rochester Railway & Light Company but with the patrons of the company as well. Having grown up with the electric-light industry in Rochester, his experience has become invaluable alike to the company and to the community. Not a little of the good will of the citizens of Rochester which the Rochester Railway & Light Company enjoys is due to the frank diplomacy of its superintendent.

Mr. M. S. Sloan has been appointed manager of the railway and electric departments of the New Orleans (La.) Railway & Light Company, to succeed Mr. D. A. Hegarty, resigned. Prior to 1906 Mr. Sloan was connected with the General Electric Company. On July 1, 1906, he was made chief engineer of the Birmingham (Ala.) Railway, Light & Power Company. Later he was made assistant superintendent of the lighting and power departments of that company, and in 1907 he was appointed superintendent of power of the company. A year later he was appointed superintendent of the electric department of the company, with jurisdiction over the operation and commercial sales of that department. In 1910 he was made assistant to the president of the company, in which capacity he had supervision over all departments of the company, with full executive power. He continued in that capacity until his recent appointment as manager of the railway and electric department of the New Orleans Railway & Light Company.

M. S. SLOAN

Mr. Harry B. Ivers, general manager of the Cumberland County Light & Power Company, Portland, Maine, for the last three years, has tendered his resignation to take effect Feb. 15. He has purchased an interest in the Frank Ridlon Company, Boston, Mass., and will become connected with that company. Mr. Ivers has long been connected with railway and lighting work in New England. His experience dates from the spring of 1893, when he entered the employ of the Hyde Park (Mass.) Electric Light Company. Mr. Ivers was connected with the railways and lighting companies later acquired by the Massachusetts Electric Companies and assisted in consolidating the accounts and in operating the railways which were organized as a division of the Old Colony Street Railway. He subsequently acted as superintendent of one of the divisions and later was transferred to Brockton and assisted in consolidating and systematizing the accounts of the separate companies in and around that city. After being connected with the property for nine years, he was elected treasurer and manager of the Westerly (R. I.) Railway & Lighting Company. Four years later he accepted the position of assistant to Mr. J. R. Graham, president and general manager of the Bangor (Me.) Railway & Electric Company, and a few months thereafter was elected treasurer of that company and of the Bar Harbor & Union River Power Company, which constructed the hydroelectric plant upon the Union River at Ellsworth, Maine. In March, 1908, Mr. Ivers was appointed general manager of the Lewiston, Augusta & Waterville Street Railway of Lewiston, Maine, and in June, 1912, was appointed general manager of the Cumberland County Power & Light Company, which controls and operates the Portland Railroad, the Portland Electric Company, the Portland Lighting & Power Company, the Consolidated Electric Light Company and the Lewiston, Augusta & Waterville Street Railway. Mr. Ivers is an ex-president of the Maine Electric Association and is now a member of the executive committee of that association and vice-president of the New England Street Railway Club and the New England Section of the National Electric Light Association.

Obituary

J. M. Oram, who was connected with the public utilities at Dallas, Tex., died at Dallas, Tex., Jan. 17. Mr. Oram was born near Bloomington, Ind., April 29, 1845, and moved to Lancaster, Tex., with his parents in 1857. He was at one time general manager of the Dallas Electric Light & Power Company, the Standard Electric Light Company and the Dallas Ice Factory Light & Power Company. During the late eighties and early nineties Mr. Oram was city electrician of Dallas. He invented numerous telephone devices and was manager of an independent long-distance telephone company established in Dallas some years ago. He is survived by his widow, three sons, two of whom are electrical engineers, and three daughters.

William H. Woolverton, of New York, president of the Gamewell Fire Alarm & Telegraph Company, died in Augusta, Ga., Jan. 21, at the age of seventy. Mr. Woolverton became a telegraph operator with the Pennsylvania Railroad at the age of fifteen years. Among his co-workers were Messrs. Andrew Carnegie, Thomas T. Eckert and David H. Bates. Mr. Woolverton was also president of the *Official Railway Guide*. He was one of the pioneers of the first telephone company in New York City and served as a director of the Metropolitan Telephone Company and the New York Telephone Company for more than thirty years. He was elected vice-president of the Gamewell Fire Alarm Company in 1890 and was made president in 1909. His widow, a son and a daughter survive him.

John Walker Wilkins, the last surviving telegraph pioneer of Great Britain, died at Kingston-on-Thames Dec. 18, in his eighty-seventh year. Mr. Wilkins was born at Hampstead March 25, 1827, and at the age of thirteen was an accomplished draftsman. He subsequently qualified for the profession of civil engineering. A remarkable predilection for electricity, however, soon brought Mr. Wilkins into prominent notice in another direction, when he became associated with Mr. William Fothergill Cooke in the erection of railway telegraphs. He was appointed resident superintendent of the Northampton & Peterborough telegraphs in July, 1845. In 1846 the Queen's speech on the opening of Parliament was for the first time telegraphed to about a dozen towns in the Midlands and north of England for publication in the local evening papers. The arrangements were in the hands of Mr. Wilkins, who was then just nineteen years old. An account of his researches and experiments in the region of wireless telegraphy was published in the *Mining Journal* March 31, 1849, and is referred to at some length in Fahie's "History of Wireless Telegraphy." In connection with his wireless apparatus Mr. Wilkins invented a delicate form of detector or galvanometer identical in principle with Lord Kelvin's apparatus for long cable working. This relay was put in use in the United States in 1851, when Mr. Wilkins came to America to assist Henry O'Reilly, of New York, who had a concession from the patentees of the Morse system for the erection of telegraphs at a stated royalty per mile. Owing to disputes between the contractor, O'Reilly, and the patentees of the Morse system, the telegraph construction work in which Mr. Wilkins was engaged came to an abrupt end, and he entered the service of contractors for the Ohio & Mississippi Railroad as a civil engineer. From 1852 until 1869 he was engaged in railroad construction work with the late Thomas Brassey, of Europe. In 1873 he became resident engineer to the contractors for the Cuxhaven docks on the North Sea. Mr. Wilkins paid a second visit to the United States in 1874, during which time he was chiefly occupied in prospecting silver mines. In returning to England in 1878 with the object of forming a syndicate for acquiring several valuable mining properties in Alabama, he found the economic conditions unfavorable, and he became associated with Sir Henry Doulton, a celebrated potter of Lambeth, visiting many countries in Europe and South America in the interest of that firm. On his return from Buenos Aires in 1893, his active service on behalf of the Doulton firm ceased. Mr. Wilkins was a frequent contributor to technical publications in England. His last visit to the United States was in the summer of 1908.

Construction

New England

YARMOUTH, MAINE.—Within the next six months the Yarmouth Ltg. Co. expects to [illegible] miles of transmission line between Freeport and Lisbon Falls and to purchase material for same, including poles, transformers, insulators, wire and lightning arrestors. Herbert H. Berry is general superintendent.

HOLYOKE, MASS.—The contract for the new 4000-kw turbine for the electric-light station has been awarded to the Westinghouse El. & Mfg. Co., at $35,000. The Deane Steam Pump Co., 115 Broadway, New York, was awarded the contract for condenser at about $11,000.

SPRINGFIELD, MASS.—The city supervisors are considering the question of establishing a central power plant in the municipal heating plant building, to furnish electricity for lamps and motors for the municipal buildings and possibly the high-school buildings.

PROVIDENCE, R. I.—At the annual meeting of the Narragansett El. Ltg. Co., of Providence, to be held Feb. 8, the proposal to issue $1,500,000 in additional stock will be submitted to the stockholders.

BRIDGEPORT, CONN. — Preparations are being made for improving the lighting system in the business district. It is proposed to erect 152 arc lamps in the district where now 19 arc lamps are in service. An appropriation of $16,000 has been asked for this improvement.

EAST HADDAM, CONN.—The East Haddam El. Lt. Co. expects to begin work on the erection of a transmission line to Colchester, when the line between Tylerville and Higganum is completed.

Middle Atlantic

BROOKLYN, N. Y.—The Public Service Commission has decided upon the location for the power plant to be used in the construction of the two new East River tunnels, the Whitehall-Montague Street tunnel of the Brooklyn Rapid Transit Co., and the Old Slip-Clark Street tunnel of the Interboro Rapid Transit Co. A lease has been effected of the old Jewell Mills property at the foot of Fulton Street, where air-compressor plants and other equipment for the work on both tunnels will be built.

BUFFALO, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 24 for changes in the conduit and wiring and lighting fixtures at the United States post office in Buffalo, N. Y., in accordance with drawings and specifications, copies of which may be obtained at the above office or at the office of the custodian, Buffalo. O. Wenderoth is supervising architect.

CHURCHVILLE, N. Y.—At a special election held recently the taxpayers voted to authorize the trustees of the village to purchase the street-lighting system of the Churchville Lt. & Htg. Co., at a price not to exceed $1,200.

LONG ISLAND CITY, N. Y.—The New York & Queens County El. Lt. & Pwr. Co., it is reported, is planning to enlarge its plant in Flushing and has purchased a plot 146 ft. by 300 ft. on Lawrence Street, between Broadway and Pine Street.

LYONS, N. Y.—Plans are being prepared, it is reported, by the Central New York Gas & El. Co. for enlarging and improving its power plant in this village, which when completed will double the output of the plant. As this station can be operated by water as well as steam and is situated on the banks of the barge canal, it will be made the chief distributing point in this district, which includes Clyde, Newark, Lyons and Palmyra.

MORAVIA, N. Y.—Plans are being considered by L. C. Reynolds, of Auburn, who recently acquired control of the Moravia El. Lt., Ht. & Pwr. Co., for improvements to the system. A day service, it is said, will be established within a short time.

RANSOMVILLE, N. Y.—A committee has been appointed by the Men's Club to make investigations in regard to securing electrical service for the village.

SAG HARBOR, N. Y.—Within the next 12 months improvements will be made to the Sag Harbor electric-light plant including the erection of 5 miles of transmission lines. New equipment will be purchased, including one tubular boiler, meters, transformers, etc.; also a small quantity of incandescent lamps, arc lamps, posts, etc. E. J. W. Meller is manager.

WATERLOO, N. Y.—The Tracy Devel. Co., which has acquired the principal water rights in Waterloo, has leased the premises which it is now occupying to the Empire Gas & El. Co., of Geneva, for a period of 50 years. The Empire company, it is stated, is contemplating erecting a large power plant upon the site. A joint petition has been filed with the Public Service Commission by the Tracy Development Co., the Central New York Gas & El. Co. and the Empire Coke Co. for the approval of the lease, etc.

WEEDSPORT, N. Y.—The property of the Weedsport El. Lt. Co. has been purchased by the Empire Gas & El. Co., of Geneva. It is understood that preparations will begin at once for the installation of a 24-hour service in Weedsport. Henry L. Coleman, of Geneva, is manager of the Empire Gas & El. Co.

WEST STOCKHOLM, N. Y.—Within the next six months George N. Gibson & Co., owners of the local electric-light plant, expect to purchase one 50-hp turbine to operate under a 10-ft. head.

YONKERS, N. Y.—The Board of Aldermen has practically decided to extend the ornamental lamp standards on Warburton Avenue to Glenwood Avenue, on South Broadway to the city line; on Ashburton Avenue and on Palisade Avenue to Ashburton Avenue.

CONEMAUGH, PA.—Within the next six months the East Taylor Lt. & Pwr. Co., of Conemaugh, expects to purchase transformers, poles, insulators, distribution cable, wire and meters, tub transformers, rectifiers and incandescent lamps (quantity not yet decided). C. B. Custer is secretary and treasurer.

DELTA, PA.—The Delta Wtr. Pwr. Co. expects to erect within the next few months about 4 miles of three-wire (No. 6) line, 6600 volts, and to purchase some lightning arresters and transformers. J. Howard Stubbs is president and manager.

HARRISBURG, PA.—Bids will be received by the board of school directors of the school district of the city of Harrisburg until March 20 for the construction of a 12-room building at the corner of Seventeenth and Catherine Streets, Harrisburg; also for heating, ventilation, plumbing and electric wiring, in accordance with plans and specifications prepared by C. Howard Lloyd, architect. Plans and specifications can be seen at the office of the architect, 701A Telegraph Building, Harrisburg. D. D. Hammelbaugh is secretary.

INTERCOURSE, PA.—The Intercourse El. Lt., Ht. & Pwr. Co. expects to erect within the next six months 4 miles of three-phase, 2300-volt transmission line (using 30-ft. poles); also to purchase within the next six months three dozen 2200-volt line arresters (pole type). Enos L. Zimmerman is secretary and treasurer.

JOHNSTOWN, PA.—The Citizens' Lt., Ht. & Pwr. Co., of Johnstown, is contemplating extending its transmission lines to Echo next Spring.

LANSFORD, PA.—Within the next three months the Panther Valley El. Lt., Ht. & Pwr. Co., of Lansford, expects to erect a substation and a 10,000-volt, 60-cycle transmission line; three 300-kva load, connected to transformer. Electricity is purchased from the Lehigh Coal & Navigation Co. The company also expects to purchase within the next 12 months about 300 meters (installed 250 meters during 1912 and added 25 arc lamps to line); also, within the next three months, to purchase rectifiers, 200 arc-lamp equipment and 200 magnetite arc lamps. W. Drumshekker is manager.

McKEESPORT, PA.—The business men on Market Street between Fourth and Sixth Avenues have asked the city commissioners for permission to erect 24 ornamental standards for cluster lamps. The cost is estimated at about $3,000.

PHILADELPHIA, PA.—Bids will be received by A. F. Hammond, superintendent of supplies, at the office of the board of education, school district of Philadelphia, Room 392, City Hall, Philadelphia, until Feb. 24, for lighting fixtures (gas and combination) for the wings to the Commodore John Barry Public School at Fifty-ninth and Race Streets; also for three speed lathes for the Central High School Annex, Seventeenth and Wood Streets. Further information, specifications, etc., may be obtained upon application to the above office.

SOUTH BETHLEHEM, PA.—A committee has been appointed to secure data as to the advisability of establishing a municipal electric-light plant in South Bethlehem.

ELIZABETH, N. J.—Bids will be received until Feb. 12 by the board of education, Elizabeth, for the installation of a complete electric power plant, consisting of engines, generators, foundation therefor, switchboard, etc., for the Bettin High School. Plans and specifications may be seen at the office of Richard D. Kimball, engineer, 15 West Thirty-sixth Street, New York, N Y., or may be obtained from Thomas F. Mackessy, business manager, board of education, City Hall, Elizabeth, upon deposit of $10, which will be refunded upon return of same.

JERSEY CITY, N. J.—Bids will be received by the Board of Commissioners until Feb. 10 for furnishing 2000-cp arc lamps (4-amp, magnetite type) and metallic flame-arc or 6.6-amp magnetite arc lamps. Specifications and estimates of quantities may be obtained at the office of the chief engineer, Room 23, City Hall. Michael I. Fagen is city clerk.

NEWARK, N. J.—Bids will be received by the Board of Education of Newark, N. J,. until Feb. 17 for the construction of the addition to the West Side School House, to be completed by Sept. 12, 1914. Bids may be submitted for the whole or one or more items as follows: Masonry, steel and iron, roofing and sheet metal, carpentry, painting, plumbing, heating and ventilation, electric work and lighting fixtures. Blank proposals may be obtained at the construction department of the board, fourth floor, city hall, where drawings and specifications, etc., may be examined. R. D. Argue is secretary of board.

PERTH AMBOY, N. J.—The Board of Aldermen is considering the advisability of establishing a municipal electric-light plant in connection with plans for the installation of an ornamental street-lighting system on State Street.

BALTIMORE, MD.—Plans are being considered for converting the western pumping station in Druid Hill Park into a power plant to furnish electricity for lighting the water department, including the new dam, the filtration plant at Lake Montebello and the different pumping stations. The new high-service pumping station provided for in the ordinance estimates for 1914, which is to be situated near the high-service reservoir in Druid Hill Park, will be operated by electricity and will cost about $50,000. E. B. Whitman is water engineer.

WILLIAMSPORT, MD.—The proposal to establish an electric-light plant and water-works system in Williamsport either under municipal ownership or by a private company will be submitted to voters at the annual election to be held in March.

WASHINGTON, D. C.—The Potomac El. Co., of Washington, is reported to be contemplating remodeling its power plant at Fourteenth and B. Streets N. W., to cost about $2,500.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until Feb. 16, for furnishing, under Proposal No. 688, one 1-kw, 500-cycle radio set (quenched-spark type, complete), with sending and receiving equipment, for installation in land station, in accordance with Specification 566, motor to operate on 110 volts, direct current.

WASHINGTON, D. C.—Bids will be received at the Engineer Depot, United States Army, Washington Barracks, D. C., until Feb. 9 for furnishing water-tight electric-lighting fixtures and accessories of special engineer department design, including 21 junction boxes, three snap switch boxes, 12 platform lamp fixtures and 69 type X outlet couplings. For further information address Lt. Col. Joseph E. Kuhn.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 24 for furnishing at the various navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 6340—10,000 ft. rubber-insulated, lead-covered, single-conductor copper cable; Schedule 6351—five electrically operated meat and food choppers, trolley hoist for 5-in. gun; Schedule 6348—3550 lb. miscellaneous weatherproof wire; Schedule 6355—1965 lb. miscellaneous soft sheet copper, 5300 lb. ½-in. (outside diameter) seamless drawn copper tubes; Schedule 6356—38,000 lb. 1½-in. class C steel boiler plates. Norwalk, Va., Schedule 6340—20,000 ft. special portable lamp wire (98 per cent pure copper). Bids will also be received until March 3 as follows: Mare Island, Cal., Schedule 6360—200 ft. flexible copper No. 1 metallic steam hose (in 20-ft. lengths). Mare Island, Cal., and Puget Sound, Wash., Schedule 6347—seven portable testing sets. Eastern yards, Schedule 6347—13 testing sets (portable motor end, 125 volts). Brooklyn, N. Y., Schedule 6358—miscellaneous rudder transmitters and indicators, complete, etc. Applications for proposals should give the schedule desired by number. T. J. Cowie is paymaster general, U. S. N.

North Central

EAST LANSING, MICH.—We are informed that the city of East Lansing is not contemplating the installation of a municipal electric plant, but may install street lamps, etc., in which case electricity for operating same would be purchased from a private company. The Michigan Pwr. Co., of Lansing, furnishes electrical service to private residences, etc., here. Reported in the issue of Jan. 24 to be considering the installation of a municipal street-lighting system. B. A. Faunce is city clerk.

HARTFORD, MICH.—Preparations are being made by Anderson Brothers, owners of the local electric-light plant, to change its system from single-phase to three-phase at once; they also expect to purchase within the next three months one generator, exciter and switchboard. A 24-hour service will be established and they will sell all electrical appliances that will be used in connection with a day service. M. J. Anderson is manager.

IDA, MICH.—Application has been made to the Village Council by Amory Kolb, of Monroe, Mich., promoter of the Raisinville dam project, for a franchise to supply electricity in this town and the territory between the Raisin River dam and the village. Other franchises covering nearby towns and the rural districts will be asked for.

KALAMAZOO, MICH.—Bids will be received until Feb. 16 by C. L. Miller, city clerk, for the purchase of machinery and equipment to replace those now in the municipal electric-light plant, as follows: One 450-hp tandem compound Russell engine, one 250-hp compound Russell engine, two Union Steam Pump jet condensers, one 500-hp Cochrane heater, one Burnham boiler-feed pump, one Dean boiler-feed pump, two 150-hp Stirling boilers and one 225-hp Stirling boiler, one four-panel marble switchboard and instruments for series arc-lighting system, line shafting, pulleys, belts, etc.

MANISTIQUE, MICH.—The Manistique Lt. & Pwr. Co. is planning to change its system from 133 cycles, single-phase, to 60 cycles, three-phase, and expects to purchase waterwheels, generators, motors, meters, etc. The present equipment of the plant consists of one 360-kw Stanley two-phase, 133-cycle generator, one 250-kw Warren, one 150-kw Warren and one 60-kw Fort Wayne generator (all 133 cycles), which is to be changed to 60 cycles, three-phase; also two new 62-in. waterwheels with a 300-kw generator. The company proposes to furnish electricity for power purposes, heating, etc., as well as for lighting. Benjamin Gero is general manager, and V. X. Lyon is superintendent.

MONROE, MICH.—The city commission contemplates improvements to the municipal electric-light plant, including the installation of a 250-hp boiler and a smokestack 125 ft. high and 66 in. in diameter. For further information address John S. McMillan, commissioner of public utilities.

WAKEFIELD, MICH.—The contract for installing the municipal electric-light plant in Wakefield was awarded to the M. & S. El. Co., of Flint, at $4,500.

YPSILANTI, MICH.—Estimates, it is reported, will be received by Smith, Hinchman & Grylls, of Detroit, until Feb. 14 for an electric elevator to be erected in the auditorium in Ypsilanti.

CELINA, OHIO.—The Board of Public Affairs expects to purchase within the next few months a 300-hp boiler and deep-well pump. George A. Petrie is clerk.

CINCINNATI, OHIO.—Bids will be received at the office of the clerk of the board of education, City Hall, Cincinnati, Ohio, until Feb. 23 for furnishing material and labor necessary to complete the electrical work and fireproof windows and doors in the new Bloom School, at the corner of Bank and Bayliller Streets, Cincinnati. Plans and specifications are on file in the office of C. W. Handman, business manager, at 511 West Court Street, Cincinnati.

CLEVELAND, OHIO.—The directors of the Cleveland El. Ry. Co. have authorized the purchase of 50 more motor cars.

CLEVELAND HEIGHTS, OHIO.—Bids will be received by the Village Council at the office of the clerk, at the town hall, 2982 Mayfield Road, Cleveland Heights, until Feb. 16, for furnishing electricity and maintaining the arc-lamp street-lighting system in the village for one year; also furnishing such additional lamps as may be put into service during said period, in accordance with plans and specifications now on file in the office of F. A. Pease, engineer, the Marshall Building, Public Square, Cleveland. Cleveland Heights has not a post office. H. H. Canfield is clerk.

DEFIANCE, OHIO.—Within the next two months the Auglaize Pwr. Co., of Defiance, expects to purchase four sets of three-pole, 33,000-volt disconnecting switches, lightning arresters and 25-kw, single-phase, 33,000/2300-volt, 23-cycle transformers. W. P. Wallace is general manager.

DRESDEN, OHIO.—The Council has appointed a committee to negotiate with the owners of the Dresden electric light plant regarding the question of furnishing electrical service here. The company has announced that it will shut off the electric street lamps in the village if a franchise is refused.

FREEPORT, OHIO.—Bids will be received at the office of H. E. West, clerk of Freeport Corporation, until Feb. 16 for furnishing electricity to light the village of Freeport; also to furnish energy for commercial lighting. The contract is to provide for not less than thirty 60-watt Hardy tungsten lamps for street-lighting.

HURON, OHIO.—The Board of Public Affairs will receive bids until Feb. 24 for one 125-kva and one 75-kva, three-phase, 60-cycle, 2300-volt generator, with exciters and switchboard to control same; also one 20-kw series regulator unit (primary 2200 volts, secondary 6.6 amp, 60 cycles). J. C. Britton is superintendent of electric-light plant and water-works.

JUNCTION CITY, OHIO.—Within the next three months the Guinsler El. Lt. & Pwr. Co., of Junction City, will rebuild its lines. The company is now changing its street-lighting system, 13 arc lamps being replaced with 39 tungsten lamps of 80 cp. W. E. Guinsler is general manager.

KENTON, OHIO.—The Hardin-Wyandot Ltg. Co., it is reported, will not build a new plant on the site which it owns in the southeastern part of the city, but will remodel its old plant located between South Main and South Detroit Streets, work on which has already begun. The cost of the improvements, including new machinery, is estimated at $40,000. P. M. Magly is local manager.

TROY, OHIO.—Within the next two months the director of public service expects to purchase 2000 lb. of weatherproof wire for the municipal electric-light system. The construction of a new power house and water-works pumping plant in the near future is under consideration. The proposal to issue $75,000 in bonds for same will be submitted to the voters. L. A. Pool is superintendent.

XENIA, OHIO.—The Xenia Gas & El. Co. is contemplating the installation of substation equipment at its present gas-engine generating station within the next three months, to receive energy from the Dayton Pwr. & Lt. Co.; also the purchase of material for extending and rebuilding its lines. F. C. Barr is superintendent.

LOUISVILLE, KY.—Crutchers & Starke, of Louisville, have leased the Equitable Building and will remodel the same. Among the improvements contemplated is the installation of two electric elevators.

ANDERSON, IND.—The superintendent of the municipal electric-light plant has submitted a report to the Board of Public Works, recommending the installation of two new boilers and new generators at the municipal electric-light plant. The board is also considering the installation of an ornamental street-lighting system (cluster lamps).

INDIANAPOLIS, IND. — The Park Board is contemplating lighting the boulevards with electricity. For further information address James H. Lowey, secretary of board.

LAWRENCEBURG, IND.—An additional engine and generator will be installed in the municipal electric-light plant to provide electricity for a day service.

RICHMOND, IND.—The Indiana Public Utilities Commission has authorized the Richmond Lt., Ht. & Pwr. Co. to issue $850,000 in bonds, to be sold at not less than 90.

SCOTTSBURG, IND.—The Indianapolis & Louisville Trac. Co., of Scottsburg, has applied to the Town Board for a franchise to furnish electricity for lamps and motors here. The company now furnishes energy to operate the municipal electric-light system.

BELVIDERE, ILL.—The Illinois Northern Utilities Co. has acquired a site on the Kishwaukee River at Main Street, for its proposed central power station, from which it will supply electricity to cities and towns within a radius of 25 miles of Belvidere. W. B. Shearman is local manager.

CHICAGO, ILL.—Bids will be received by the city of Chicago until Feb. 11, Room 406, City Hall, Chicago, for furnishing and installing cables in elevators Nos. 1, 2, 3, 6 and 7 in the City Hall Building, according to plans and specifications on file in the office of the Department of Public Works, Room 406, City Hall. L. E. McGann is commissioner of public works.

CHICAGO, ILL.—Bids will be received until Feb. 9 by the commissioner of gas and electricity, Room 614, City Hall, Chicago, until Feb. 9, for furnishing to the Department of Gas and Electricity of the city of Chicago electrical supplies in accordance with specifications as follows: 100,000 ft. No. 14 twin wire, or its cost equivalent in other sizes; 40,000 ft. ½-in. rigid conduit, or its cost equivalent in other sizes; 1000 ft. ½-in. "T" type outlet boxes, or their cost in other types and sizes. Proposals to be made out upon blanks furnished by the commissioner of gas and electricity. Ray Palmer is city electrician.

SPRINGFIELD, ILL.—At a special election held Jan. 27 the proposal to amalgamate the municipal electric-light plant with the city water-works on the banks of the Sangamon River was carried. The immediate proposition voted upon was the installation of an electric generator, to cost $20,000, in the water-works station.

SPRINGFIELD, ILL.—Plans and specifications have been completed for the erection of an auxiliary plant to increase the heating facilities of the Springfield Lt., Ht. & Pwr. Co. The station will be erected on Third Street, between Adams and Monroe Streets, and will furnish heat for residences in outlying districts as well as downtown.

BALDWIN, WIS.—The Baldwin El. Co., it is reported, is planning to install a generator and establish a 24-hour service.

JUNEAU, WIS.—The installation of a municipal electric-light plant in Juneau is under consideration.

MENASHA, WIS.—Within the next six months the electric light commissioners expect to establish an exclusive power service on present pole lines; also to purchase within the next six months lightning arresters, incandescent street-lighting fixtures, and to establish a department to sell heating and cooking appliances. John H. Knester is city electrician.

WEST SALEM, WIS.—The Wisconsin Railroad Commission has given the Neshonac Lt. & Pwr. Co., of West Salem, three weeks in which to submit plans and specifications for the construction of a hydroelectric power plant, which will permit additional units to be installed.

DASSEL, MINN.—An electrical construction company, it is reported, has been formed by W. R. Rutledge, of Howard Lake, and Ernest Johnson, of Dassel, with headquarters in this city. The company will have charge of all the wiring and erecting the service lines of the Pwr. Distribution Co.

DULUTH, MINN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 27 for construction of mailing platform extension, including mechanical equipment, lighting fixtures and changes in approaches, at the United States post office at Duluth, Minn., in accordance with plans and specifications, copies of which may be obtained at the above office or from the custodian of site. O. Wenderoth is supervising architect.

MINNEAPOLIS, MINN.—Plans, it is reported, are being prepared by Long, Lamoreaux & Long, architects, 830 Hennepin Avenue, Minneapolis, for the erection of a 14-story hotel, which, it is said, include an electric plant.

RED WING, MINN.—The Red Wing Gas Lt. & Pwr. Co. has entered into a contract with the city of Red Wing to furnish power to operate the water-works pumping station.

ST. CLOUD, MINN.—The Pwr. Distribution Co., of Minneapolis, it is reported, has made arrangements to finance its project and work will soon begin on its system. Electricity will be generated in St. Cloud with auxiliary stations at Howard Lake and Eden Valley. W. Baer Ewing, of Minneapolis, is president.

STEWARTVILLE, MINN.—A movement has been started to call an election to vote on the proposal to issue $15,000 in bonds to establish a municipal electric-light plant in Stewartville.

WABASHA, MINN. — The Minnesota-Wisconsin Pwr. Corpn., of Wabasha, has closed contracts with the municipalities of Lake City, Prescott and Hastings, Minn., to furnish electrical service in those towns.

WEST ST. PAUL, MINN.—Bids will be received by the board of education of Special School District No. 2, of Dakota County, and the city of West St. Paul until Feb. 14 for the erection of a graded school building, according to plans and specifications on file in the office of the city clerk of West St. Paul, for which separate bids are to be submitted as follows: (a) general construction, (b) heating and ventilating, (c) plumbing and sewage disposal, (d) electric wiring. Plans may be seen at the

residence of the city clerk, 862 Deepe Avenue, West St. Paul; Builders' Exchange, St. Paul, and at the office of Alfred H. Wheeler, architect, 416 Globe Building, St. Paul. M. P. Boege is secretary of school board.

CENTERVILLE, IA.—The Centerville Lt. & Trac. Co. is reported to have purchased the entire interest of the Southern Iowa Trac. Co., a steam railroad, operating between Centerville and Albia, a distance of 30 miles. It is understood that the road will be equipped for electrical operation (overhead trolley system). Two electric passenger cars and one combination baggage and express car will be purchased.

EAGLE GROVE, IA.—Bids will be received by the City Council until Feb. 19 for the construction of a city hall and fire station, building to be 50 ft. by 88 ft.; also for electric wiring, plumbing and heating. Samuel Middleton is city clerk.

LOHRVILLE, IA.—At an election held recently the proposal to install an electric-lighting system in Lohrville was carried.

MERRILL, IA.—Bonds to the amount of $3,500, it is reported, have been voted, the proceeds to be used for an addition to the municipal electric-light plant.

OTTUMWA, IA.—The Ottumwa Ry. & Lt. Co., it is reported, contemplates erecting a transmission line to Bloomfield to furnish electricity for lamps and motors in that city.

RED OAK, IA.—The City Council has entered into a new contract with the Red Oak El. Co., under the terms of which a new street-lighting system will be installed. The contract provides for the installation of 50 five-lamp electroliers on and near the square and 30 single-lamp electroliers on the street leading to the railway station. In addition to these there will be 200 tungsten lamps of 60 cp erected throughout the town.

WILLIAMSBURG, IA.—As soon as a franchise has been granted and other matters settled the Williamsburg El. Co. will install an electric-light system in Williamsburg. To start with transformers only will be needed; later on a switchboard will be required. Frank D. Gue is interested in the company.

ALBANY, MO.—The city of Albany has just completed the installation of a 150-hp boiler, one 100-kw and one 125-kw generator, together with heater pumps, switchboard and auxiliaries; also an ornamental street-lighting system, consisting of 30 posts. W. E. Noonan is superintendent.

DE SOTO, MO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 13 for construction, complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at De Soto. Drawings and specifications may be obtained from the above office or from the custodian of site. O. Wenderoth is supervising architect.

ST. LOUIS, MO.—The St. Louis Southwestern R. R. Co., it is reported, will put into use eight gas electric cars in the passenger service on its short lines during the approaching season. The company has recently obtained permission from the State Public Service Commission to issue notes to the amount of $340,000, part of which will be used to purchase the new cars.

HUNTER, N. D.—The Hunter Lt. & Pwr. Co. expects to purchase within the next eight months a small generator and gas engine and material for distribution system; also electrical appliances and supplies, including heating and cooking apparatus, vacuum cleaners, washing machines, etc. M. P. Branden is manager.

LA MOURE, N. D.—Contracts will be awarded by the La Moure Lt. & Pwr. Co. for construction of an electric-light plant. The equipment will include a Smitn gas producer, Bruce-Macbeth gas engine, generators (2300-volt), Northwestern El. Co. switchboard equipment, Peerless transformers and Westinghouse meters. M. A. Erickson, of La Moure, is engineer in charge.

LINTON, N. D.—The installation of an electric-light plant is under consideration by the business men of Linton.

MINOT, N. D.—Bids will be received by the board of education of Minot until March 2 for the erection of an eight-room school building, in accordance with plans and specifications prepared by R. T. Frost, architect, which may be seen at the offices of the clerk of the board of education and of the architect, Minot, and at the Builders & Traders' Exchange in Minneapolis and St. Paul, Minn., and Fargo and Grand Forks, N. D. Separate bids to be submitted as follows: (a) general construction of building; (b) heating, plumbing and ventilating; (c) electrical wiring. S. W. Nicodemus is clerk of board.

WALHALLA, N. D.—The Walhalla Roller Mill Co., of Walhalla, expects, within the next 12 months, to build a dam across the Pembina River for power purposes, also to purchase some wiring supplies. The old dam of the company has been washed out. W. A. Andrews is secretary and treasurer.

WHITE EARTH, N. D.—Within the next six months the White Earth Electric Association expects to purchase a storage-battery system (either a 240-amp-hr. or 300-amp-hr. or a 6-hp auxiliary generating outfit). Fred Hermanson is manager.

ELK POINT, S. D.—A special election will be held to vote on the proposal to issue bonds for the installation of an electric-light plant.

PARKER, S. D.—A special election will be called to submit the proposal to issue $20,000 in bonds for the installation of a municipal electric-light plant in Parker.

ANSELMO, NEB.—The Anselmo El. Lt. & Pwr. Co. is planning to install an electric light and power plant in Anselmo, to cost from $4,000 to $5,000. The equipment will consist of a 25-hp Fairbanks-Morse engine and Fairbanks-Morse compound, direct-current generator, switchboard (type L. B.) with storage batteries; 1½ miles of overhead distribution lines using from 25-ft. to 40-ft. poles, about six arc-lamps and 20-cp tungsten lamps. S. Lowritzen, of Grand Island, Neb., is engineer in charge. David Christen is interested in the company.

DECATUR, NEB.—Preparations are being made for the installation of a municipal electric-light plant in Decatur, for which bonds have been voted and plans and specifications prepared.

FRANKLIN, NEB.—The city of Franklin expects to purchase within the next 12 months material for distributing and lighting systems and electrical appliances and supplies for the municipal electric-light system as the demand requires. A. S. Creighton is superintendent.

KEARNEY, NEB.—The City Council has decided to submit the proposal to issue $12,000 in bonds for a municipal electric-light plant to the voters.

NORTH PLATTE, NEB.—The property of the North Platte Gas & El. Co. has been purchased by William Tood and J. W. Parrish, of Omaha. The new owners, it is said, are interested in the Birdwood water-power project, and electricity generated on Birdwood Creek will be used to operate the local system.

OVERTON, NEB.—A petition has been presented to the Village Council to call a special election to submit the proposal to issue $5,900 in bonds to purchase the local electric-light plant or install a new plant to the voters.

RED CLOUD, NEB.—Sealed proposals will be received by the board of commissioners, Red Cloud, Neb., until Feb. 24, for the construction and equipment of a county court house building, in accordance with plans and specifications prepared by W. F. Gernandt, architect, Karbach Building, Omaha. E. W. Ross is county clerk. Plans and specifications will be furnished upon deposit of $50 for contract "A" for general contract, which includes wiring, etc.

WILBER, NEB.—The town of Wilber has recently completed the installation of a new alternating-current system in connection with the municipal electric-light plant. Within the next two months electrical appliances, including heating and cooking apparatus, vacuum cleaners, washing machines, etc., will be purchased as the demand requires. E. E. Dundee is superintendent.

OSAGE, KAN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 11, for construction, including mechanical equipment, lighting fixtures and approaches, of the United States post office at Osage City, Kan. Drawings and specifications may be obtained at the above office or from the custodian of site at Osage City. O. Wenderoth is supervising architect.

OSBORN, KAN.—The City Council is considering plans for remodeling the municipal electric light and power plant.

Southern States

FAYETTEVILLE, N. C.—The city of Fayetteville has engaged the J. B. McCrary Co., of Atlanta, Ga., to supervise the installation of a new municipal electric-light plant. The cost of the plant complete is estimated at about $50,000.

LONG ISLAND, N. C.—We are informed that the Long Island Cotton Mills do not contemplate any extensive improvements this year. Reported to be contemplating the construction of a hydroelectric plant at Buffalo Shoals in the issue of Jan. 24.

TARBORO, N. C.—The city of Tarboro expects to purchase within the next ten months one 400-hp water-tube boiler for the municipal electric-light plant. C. P. McClun is light commissioner.

CAMDEN, S. C.—Contracts have been awarded for the construction of a municipal electric-light plant and water-works system, to cost approximately $125,000. Tucker & Laxton, of Charlotte, N. C., were awarded the contract for general construction at $61,976. The street-lighting system will consist of 215 tungsten lamps of 100 cp. In the business section cluster lamps will be erected. Plans and specifications were prepared by Gilbert C. White, of Charlotte, who will supervise the work.

BAINBRIDGE, GA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 14, for construction, complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Bainbridge. Drawings and specifications may be obtained at the above office or from the custodian of site at Bainbridge. O. Wenderoth is supervising architect.

EASTMAN, GA.—The Eastman Lt. & Ice Co. is reported to have awarded contract for a 12-ton ice plant. The company will erect a 22-ft. by 66-ft. building. Electrical equipment will also be installed. W. E. Davidson is manager.

MELBOURNE, FLA.—An election will soon be held to vote on the proposal to issue $5,000 in bonds to construct an electric-light system.

OCALA, FLA.—Within the next 10 months the managers of the municipal electric-light plant expect to erect a new power station and amalgamate with the water-works system just taken over by the city; also to purchase two generators, from 250 kw to 300 kw each, two water-tube boilers and switchboard to control above equipment; also two 50-lamp transformers for street-lighting system. J. C. Caldwell is superintendent.

SOUTH PITTSBURG, TENN.—Arrangements have been completed by the South Pittsburg Lt. & Pwr. Co. for the erection of a transmission line from the hydroelectric power plant at Hale's Bar, Tenn. The company will, it is said, furnish electricity in Jasper, Whitwell, Bridgeport and other Tennessee towns.

BAY MINETTE, ALA.—A special committee, consisting of W. D. Stapleton, F. E. Bartmess and E. Edmundson, has been appointed by the Bay Minette Agriculture and Civic League to make arrangements to secure a lighting system in Bay Minette.

ARAPAHO, OKLA.—The Arapaho Lt. & Wtr. Co. expects to purchase within the next six months wiring supplies to the amount of $200. W. H. Bell is superintendent.

CUSHING, OKLA.—The Cushing El. Lt. & Pwr. Co. is erecting 2 miles of three-phase, 60-cycle, 2300-volt transmission line to furnish electricity to operate a 60-hp pumping outfit. Within the next two months the company expects to purchase one switchboard feeder panel (three-phase, 60-cycle), an oil switch and two 60-kw transformers. H. Askin is secretary and manager of the company.

KINGFISHER, OKLA.—The Water and Light Department expects to purchase within the next two months one carload of poles (for general repair work only). The department is contemplating installing three blocks of curb lamps, to replace the present arc-lamp system within the next year. A. E. Fümf is superintendent of the water and light department.

NORMAN, OKLA.—The Norman Milling & Grain Co. expects to install a 200-kva generator within the next 30 days; also to purchase a 225-hp Diesel oil engine.

SHATTUCK, OKLA.—Within the next 12 months the Water and Light Department expects to purchase a motor-driven pump. A. F. Breunnecke is superintendent.

STRATFORD, OKLA.—The City Council has engaged the Benham Engineering Co., of Oklahoma City, to make investigations, prepare plans, etc., for the installation of a municipal electric-light plant and water-works system. An election will soon be called to vote on the proposal to issue $35,000 in bonds for same.

COTULLA, TEX.—The City Council has granted E. B. Zachry a 25-year franchise to construct and operate an electric-light plant in Cotulla. Work on the plant is to begin within 90 days.

WINTERS, TEX.—The capital stock of the Winters Lt. & Pwr. Co. has been increased from $10,000 to $15,000. The company, it is understood, will enlarge its plant here.

Pacific States

KALAMA, WASH.—The power house of the Washington-Oregon Corpn., including three generators and all electrical machinery, was destroyed by fire on Jan. 20, causing a loss of about $45,000. The plant is located at the falls of the Kalama River, 6 miles east of Kalama, and furnishes electrical service to the towns between Vancouver and Centralia. It is understood that the company will rebuild on a larger scale.

SEATTLE, WASH.—The Board of Public Works has awarded the contract for furnishing and installing machinery in the steam auxiliary plant of the Cedar River lighting system on the east shore of Lake Union to C. C. Moore & Co., of Seattle, at $154,500. This installation will add 5000 kw to the municipal electric system.

TACOMA, WASH.—The City Council has passed an ordinance authorizing an issue of $75,000 in bonds for the construction and equipment of a municipally owned street-car line from the business section to the Tide Flats. The proposed line will be built at once and will be about 1 mile long.

ALBANY, ORE.—The Oregon Pwr. Co. is planning to increase the output of its local hydroelectric plant at a cost of from $7,000 to $10,000. This is one of the many improvements contemplated by the company. A. Norman is local manager.

Canada

WINNIPEG, MAN.—Tenders will be received by the Commissioners of the Greater Winnipeg Water District, 901 Boyd Building, Winnipeg, until Feb. 11, for furnishing all tools and material, excepting rails and sundry steel, and for building of grade and laying track for 85 miles (more or less) of standard gage railway; also for supplying tools and material, except poles, and for building a telephone line between Shoal Lake and Transcona. Information for bidders, specifications and form of tender will be on file at the office of the commission, S. H. Reynolds is chairman of commissioners.

KERROBERT, SASK.—Tenders will be received by J. W. Lauman, secretary and treasurer, for construction of water-works system, including pumping machinery. Plans and specifications may be seen at Kerrobert, Sask., or at the offices of Chipman & Power, consulting engineers, in Winnipeg, Man., and Toronto, Ont.

Miscellaneous

SYDNEY, NEW SOUTH WALES, AUSTRALIA.—Tenders will be received by the New South Wales Government Railroad Department until March 25 for furnishing and delivering to the tramway substations at Sydney five 1000-kw converters, 15 365-kw single-phase transformers, four blower sets and accessories. Copies of specifications, etc., may be obtained at the office of the electrical engineer, New South Wales Government Railways and Tramways, 61 Hunter Street, Sydney, upon payment of $2.44 each.

New Incorporations

PHILADELPHIA, PA.—A charter has been granted to the Fairmont Park Lt. & Pwr. Co. to construct and operate an electric-light plant. C. E. Platt, Pennsylvania Building, Fifteenth and Chestnut Streets, Philadelphia, is president of the company.

CHATTANOOGA, TENN.—The Tennessee Valley Lt. & Pwr. Co. has filed articles of incorporation with a capital stock of $1,100,000. The company has offices in Worcester and Chattanooga, Tenn. The incorporators are F. S. Stranahan, of Providence, R. I., and W. E. Wardinel, of Worcester, Mass.

WATERTOWN, MINN.—The Crescent El. Co. has been incorporated by Guy E. Halgren, James J. Ponsford and Arthur C. Halgren, all of Watertown, Minn., and George E. Hanscom, of St. Cloud, Minn.

Directory of Electrical Associations, Societies, Etc.

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, H. O. Hanson, Mobile Gas Co., Mobile, Ala. Semi-annual meeting, Mobile, Ala. May, 1914.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Permanent secretary, L. O. Howard, Smithsonian Institution, Washington, D. C.

AMERICAN ELECTRIC RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary-treasurer, E. B. Burritt, 29 West 39th St., New York.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 29 West 39th St., New York.

AMERICAN ELECTRIC RAILWAY ENGINEERING ASSOCIATION. Secretary, E. B. Burritt, 29 West 39th St., New York.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS. Secretary, Eugene W. Stern, 101 Park Ave., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS. Secretary, William H. Ross, 154 Nassau St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. Secretary, Edwin A. Scott, 29 West 39th St., New York.

AMERICAN WATER WORKS ASSOCIATION. Secretary, J. M. Diven, 47 State St., Troy, N. Y. Annual meeting, May.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, W. J. Tharp, Little Rock, Ark. Annual meeting, May.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Geo. C. Holberton, Pacific Gas & Electric Co., San Francisco, Cal.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, W. T. Snyder, McKeesport, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Jos. A. Andreucetti, Chicago & Northwestern Railway, Chicago.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, 112 West Adams St., Chicago. Annual meeting, New Orleans, May 19-22.

CALIFORNIA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, W. S. Hanbridge, 1408 Merchants' National Bank Building, Los Angeles, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Affiliated with N. E. L. A. Secretary-treasurer, J. H. Larmonth, 610 Confederation Life Bldg., Toronto, Can.

COLORADO ELECTRIC CLUB. Secretary, C. F. Oehlmann. Meets every Thursday at Albany Hotel, Denver, Col.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy, 900 15th St., Denver, Col.

COMMERCIAL SECTION, N. E. L. A. Secretary, J. F. Becker, 1170 Broadway, N. Y.

EASTERN NEW YORK SECTION, N E. L. A. Secretary, C. S. Van Dyck, Schenectady, N. Y.

ELECTRIC CLUB OF CHICAGO. Secretary, Fred M. Rosseland, Monadnock Block, Chicago. Meets every Thursday noon at Hotel Sherman.

ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER BOSTON. Secretary, R. S. Hale, 39 Boylston St., Boston.

ELECTRICAL CONTRACTORS' ASSOCIATION OF MASSACHUSETTS. Secretary, H. D. Temple, 30 Foster St., Worcester, Mass.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

ELECTRICAL CONTRACTORS' ASSOCIATION OF THE CITY OF CHICAGO. Secretary, M. N. Blumenthal, 179 West Washington St. Meets at noon on the second and fourth Wednesday of each month at 424 South Wabash Ave.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, A. J. Burns, 318 West Tenth St., Kansas City, Mo.

ELECTRICAL CONTRACTORS' ASSOCIATION OF WISCONSIN. Secretary, Albert Petermann, 626 Lloyd St., Milwaukee, Wis.

ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago.

ELECTRICAL CREDIT ASSOCIATION OF PHILADELPHIA. Secretary, John W. Crum, 1324 Land Title Building, Philadelphia, Pa.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Meeting, San Francisco, second Thursday of each month.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Secretary, Harvey Robinson, 124 West 42d St., New York.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA, NEW ENGLAND SECTION. Secretary, L. L. Edgar, 39 Boylston St., Boston.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

FARADAY ELECTRICAL ASSOCIATION. Secretary, W. J. Collins, 1129 Masonic Temple, Chicago. Meets at noon on the first and third Wednesday of each month at Planters' Hotel.

GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION OF OKLAHOMA. Secretary-treasurer, Prof. H. V. Bozell, Norman, Okla. Annual meeting, May, 1914.

HYDROELECTRIC SECTION, N. E. L. A. Secretary, S. A. Sewall, 29 West 39th St., N. Y.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, J. D. Israel, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia, Chicago and Pittsburgh.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, A. Newburger, 1153 Myrtle Ave., Brooklyn, N. Y.

INDEPENDENT TELEPHONE ASSOCIATION OF AMERICA. Secretary, W. S. Vivian, Grand Rapids, Mich.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donahue, Lafayette, Ind.

INSTITUTE OF OPERATING ENGINEERS. Secretary, L. Houmiller, 29 West 39th St., New York.

INSTITUTE OF RADIO ENGINEERS. Secretary, E. J. Simon, 81 New St., New York.

INTERNAL-COMBUSTION ENGINEERS' ASSOCIATION. President, Charles Kratsch, 416 West Indiana St., Chicago. Meeting second Friday of each month at Lewis Institute.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ELECTRICAL CONGRESS. Secretary, Dr. E. B. Rosa, Bureau of Standards, Washington, D. C. San Francisco, Sept. 13-18, 1915.

INTERNATIONAL ENGINEERING CONGRESS. Secretary-treasurer, W. A. Cattell, Foxcroft Building, San Francisco, Cal. Congress, San Francisco, September, 1915.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England. Meeting at San Francisco, Sept. 6-11, 1915.

IOWA ELECTRICAL ASSOCIATION. Affiliated with N. E. L. A. Secretary, H. B. Maynard, Waterloo, Ia.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia. Annual meeting, Cedar Rapids, April 23, 1914.

JOVIAN ORDER. Jupiter (president), W. N. Matthews, St. Louis, Mo.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary-treasurer, Ivor Thomas, 237 South Main St., Wichita, Kan.

LOUISIANA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, J. J. Ziegler, 227 Bourbon St. Meeting every Wednesday, Audubon Building, New Orleans.

MAINE ELECTRIC ASSOCIATION. Secretary-treasurer, Walter S. Wyman, Waterville, Maine.

MICHIGAN ELECTRIC ASSOCIATION. Affiliated with N. E. L. A. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich.

MINNESOTA ELECTRIC ASSOCIATION. Secretary-treasurer, F. A. Otto, St. Paul Gas Light Company, St. Paul, Minn. Annual meeting, Minneapolis, March, 1914.

MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the National Electric Light Association. Secretary-treasurer, Frank J. Duffy, Natchez, Miss.

MISSOURI ELECTRIC, GAS, STREET RAILWAY AND WATER WORKS ASSOCIATION. Secretary-treasurer, F. D. Beardslee, Union Electric Light & Power Co., St. Louis. Annual meeting, May.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, Wm. L. Smith, Concord, Mass.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Annual meeting, Philadelphia, May, 1914.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, George H. Duffield, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago. Annual meeting, June, 1914.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass. Open meeting, New York, March, 1915.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, J. B. Earle, Waco, Tex.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, S. J. Bell, David City, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 60 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, H. A. Faulkner, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, S. J. Stewart, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesday of each month.

NEW YORK ELECTRIC RAILWAY ASSOCIATION. Secretary, Charles C. Dietz, 598 Broadway, Albany, N. Y.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Affiliated with the National Electrical Credit Association. Secretary, Franz Neilson, 80 Wall St., New York.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York. Annual meeting, New York, June, 1914.

NORTHWESTERN CEDARMEN'S ASSOCIATION. Secretary, R. N. Boucher, 743 Lumber Exchange, Minneapolis, Minn.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio.

OREGON ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, F. C. Green, 291 East Morrison St., Portland, Ore. Annual meeting, April.

PENNSYLVANIA ELECTRIC ASSOCIATION (State Section N. E. L. A.). Secretary-treasurer, S. C. Pohe, Bloomsburg, Pa.

RAILWAY SIGNAL ASSOCIATION. Secretary-treasurer, C. E. Rosenberg, Times Building, Bethlehem, Pa.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Prof. H. H. Norris, Ithaca, N. Y. Annual meeting, Princeton, N. J., June.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, A. A. Wilbur, Columbus, Ga. Annual meeting, Isle of Palms, Charleston, S. C., Aug. 19-21, 1914.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 405 Slaughter Building, Dallas, Tex. Annual convention, Galveston, Tex., May 20-23.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Manchester, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 76 West Monroe St., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, George Allison, Stephenson Building, Milwaukee, Wis.

Weekly Record of Electrical Patents

UNITED STATE PATENTS ISSUED JAN. 27, 1914.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

1,085,102. INSULATING COMPOUND; L. E. Barringer, Schenectady, N. Y. App. filed Aug. 7, 1907. Dense machinable compound of linseed oil, zinc oxide and sulphur.

1,085,108. PEDAL OPERATOR; J. C. Cake, Chester, Pa. App. filed Jan. 12, 1911. For operating pedals of piano-player.

1,085,116. DYNAMO-ELECTRIC MACHINE; F. H. Ford, Milwaukee, Wis. App. filed July 3, 1913. Babbitt metal poured in coincident grooves in the frame and in the laminated core within the frame to lock parts together.

1,085,124. PRINTING-TELEGRAPH RECEIVER; G. S. Hiltz, New York, N. Y. App. filed April 8, 1912. "Stock-ticker."

1,085,142. SELECTIVE SIGNAL TRANSMITTER; M. Levison, Chicago, Ill. App. filed Jan. 3, 1913. For transmitting electrical impulses indicating different number signals.

1,085,151. INDUCTION-MOTOR CONTROL; M. Milch, Budapest, Austria-Hungary. App. filed Sept. 12, 1911. Has alternating-current commutator machine and a frequency changer.

1,085,163. ELECTRIC METER; P. Rose, Berlin, Germany. App. filed Sept. 1, 1911. Oscillating armature type.

1,085,215. PUSH-BUTTON; A. Lungen, New York, N. Y. App. filed Sept. 7, 1912. Flush type for mounting in a desk top, etc.

1,085,266. SWITCHING DEVICE FOR ELECTRIC CIRCUITS; M. Kallmann (deceased), Berlin, Germany. App. filed June 26, 1906. Iron or other high temperature coefficient resistance inserted at breaking point of circuit to weaken current and so reduce sparking.

1,085,282. MOWER; F. D. Mercer, Toronto, Ontario, Canada. App. filed Feb. 3, 1913. Electrically heated flexible cutter bar, pulled through the grain or grass to cut the same.

1,085,309. LEAKAGE INDICATOR AND CONNECTIONS; E. B. Wedmore, Rugby, England. App. filed March 8, 1911. Employs another coil acting in opposition to each series coil of the relay.

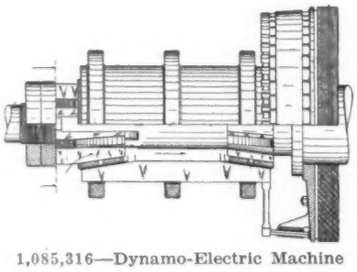
1,085,316. DYNAMO-ELECTRIC MACHINE; T. S. Allen, Milwaukee, Wis. App. filed Feb. 28, 1910. Air-circulating passages beneath the commutator bars to keep commutators in high-speed turbo machines cool.

1,085,318. TROLLEY; D. E. Bartin (deceased), Milwaukee, Wis. App. filed Sept. 16, 1909. Contact shoes as auxiliary to the trolley wheel; oil reservoir in hub of trolley, into which the contact brush extends.

1,085,340. APPARATUS FOR ELECTRIC IGNITION; G. Honold, Stuttgart, Germany. App. filed March 29, 1911. Advances and retards the effect of the explosion by varying the number of sparks employed for igniting the mixture.

1,085,347. ELECTROMAGNETIC LOCK; L. L. Leduc, Paris, France. App. filed Nov. 29, 1912. Current reverser employed for changing the polarity of a sliding soft-iron bolt operating as the core of a solenoid.

1,085,375. SECTIONING MEANS FOR ELECTRIC STATIONS; E. Branderburg, Brussels, Belgium. App. filed Oct. 2, 1911. Sectioning interrupters are made automatic in their action.



1,085,316—Dynamo-Electric Machine

1,085,393. APPARATUS FOR REDUCING ELECTRIC CURRENTS; R. J. Ward, Dunton, N. Y. App. filed July 22, 1912. For reducing high-voltage current to lower voltage for ringing bells, etc.

1,085,398. ELECTRIC SWITCH; F. Barr, New York, N. Y. App. filed Oct. 5, 1911. Rotary contacts and oscillating operating button; wall and socket types.

1,085,412. ELECTRIC ALARM CLOCK; F. Goss, Millicent, South Australia. App. filed Dec. 5, 1912. "Program clock" for sounding series of alarms at predetermined times.

1,085,433. ELECTRICAL SIGNAL APPARATUS; W. Kepler, Allenville, Ill. App. filed June 23, 1913. Push-button having contact spring which may be rotated to bring it into register with any one of a series of circuit terminals.

1,085,440. METHOD OF AND FURNACE FOR SECURING PRODUCTS OF REACTION BY ELECTRIC DISCHARGES IN GASES; C. F. R. von Koch, Stockholm, Sweden. App. filed Sept. 11, 1912. Gases pass from heating chamber through narrow passage into cooler, and electric discharge takes place through said narrow passage.

1,085,454. AUTOMATIC SWITCH; F. R. McBerty, Antwerp, Belgium. App. filed Dec. 26, 1912. Radially and axially displaced contacts arranged around a rotating contact-making shaft.

1,085,485. AUTOMATIC SWITCH FOR TRACTION LINES; F. Rice, Dayton, Ohio. App. filed April 14, 1909. Switch under control of motorman and operated by the car as it approaches the switch.

1,085,496. APPARATUS FOR TYPEWRITING AT A DISTANCE; H. E. M. Schnürer, Berlin, Germany. App. filed April 20, 1911. May be operated either as a transmitter or a receiver.

1,085,497. CONNECTOR FOR ELECTRIC-CURRENT-CARRYING CONDUCTORS; H. Schroeder, Sollitt, Ill. App. filed April 22, 1913. Coupling between the cars in a train telephone system.

1,085,511. GRAPHIC RECORDER; C. B. Thwing, Philadelphia, Pa. App. filed Aug. 27, 1911. For making a single record from a plurality of sources.

1,085,514. DYNAMO-ELECTRIC MACHINE; R. B. Williamson, Milwaukee, Wis. App. filed Nov. 21, 1910. Air-circulating system for cooling high-speed turbo-alternators.

1,085,523. HEAT TREATMENT OF METAL BODIES; J. H. Barker, Birmingham, Eng. App. filed June 4, 1913. For annealing the ends of metal cartridge cases.

1,085,546. DISINFECTING DEVICE; J. G. Cory, Coffeyville, Kan. App. filed March 11, 1913. Attachment interposed between the telephone mouthpiece and the body of the transmitter.

1,085,579. OZONE GENERATOR; S. Held, Chicago, Ill. App. filed May 26, 1913. Embodies concentrically spaced dielectric hollow bodies forming an ozone chamber between them.